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Effect of tongue reconstruction following hemiglossectomy on articulation and speech intelligibility

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ABSTRACT

Aim: This study is aimed to investigate the articulatory functions of patients who have undergone tongue reconstruction following hemiglossectomy. The second aim of the study is to compare the speech intelligibility between hemiglossectomy patients who have undergone tongue reconstruction using pectoralis major myocutaneous with those hemiglossectomy patients who had undergone tongue reconstruction using radial forearm free flap.

Materials and Methods: Fourteen patients who have undergone tongue reconstruction following hemiglossectomy as a treatment for oral cancer between the age of 30 to 60 years were taken up for this study. Tamil Articulation Test was used for assessing the articulatory functions of patients. The speech intelligibility of each patient was assessed using the Ali Yavar Jung National Institute for the Hearing Handicapped intelligibility rating scale.

Results: Analysis of articulatory errors revealed linguoalveolar consonants were more impaired when compared to other consonants. Patients with radial forearm free flap had somewhat better speech intelligibility compared to patients with pectoralis major myocutaneous flap reconstruction.

Conclusion: The type of reconstruction also impacts the speech intelligibility. Effective intervention can be planned based on the comprehensive speech evaluation and analysis of articulatory error relative to place and manner of production.

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1. Introduction

Oral cancer and its intervention are both frequently affect the speech function. The extent and site of tumor influences the extent as well as phenomenology of deterioration of speech.¹⁻³ Shortly after the intervention, speech deterioration, limitation in swallowing, changes in facial appearance and psychological problems are encountered by a significant number of patients.⁴⁻⁸ longitudinal data report that there is gradual improvement in the quality of life after intervention during the first

year,⁹⁻¹¹ but swallowing and speech issues continue to exist.¹²⁻¹⁴ The tongue is considered to be the most common site for intraoral carcinoma in many countries.¹⁵ the major treatment for lingual cancer consist of glossectomy, radiotherapy and chemotherapy. Glossectomy means the various surgical procedures done for the resection of tumors of the tongue.^{16,17} Immediate reconstruction must be performed after complete removal of tumor.¹⁸ Contemporary reconstruction of tongue has been mostly assisted by free flap, making it feasible to tailor the flap accurately to the defect.¹⁹ The glossectomy impact the speech sound production. The residual segment of tongue following glossectomy is unable to make appropriate

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contacts in precise, rapid pattern which leads to speech sound distortions. Changes in tongue shape and also size consequently results in changes in vocal tract resonance, reduction in pitch and pitch range range, guttural quality of voice, changes in nasality, and increased oral and pharyngeal noises.,^{20,21} speech intelligibility following glossectomy depends on the amount of intact tissue.^{22,23} The factors that influence the speech following glossectomy are the amount of tissue that was surgically removed and its site,²³ flexibility of the residual part of tongue, especially in the middle and rear position,²⁴ the extent to which the remaining other structures (lips, teeth, palate, pharynx, larynx) required for speech remains intact, the type of reconstruction of soft tissue that was performed.²⁵

Jaya, saravanan, rangathan and Gandhi (2016)²⁶ conducted a study in patients with tongue cancer following surgery, they reported that substitution, distortions as well as omission of bilabial, lingual-alveolar and linguo-palatine sounds were the most common articulation errors, along with impaired speech intelligibility.

Burtet, Grando, and Mituuti (2020)²⁷ mentioned that in patients who undergone glossectomy due to tongue cancer, the most common alteration in speech were distortion in lingual-alveolar sounds such as // and // as well as lingual-palatals sounds such as /s/, /z/, / ʃ /, /3 / in addition to articulatory inaccuracy.

To improve postoperative outcomes, flap repair is preferable method of the deformity after major surgery. For reconstruction of defects in soft tissue, radial forearm free flaps and pectoralis major myocutaneous flap have found to be more reliable.²⁸ If greater than 50% of the tongue is surgically resected, flap reconstruction is generally required.^{29–31}

Su, Hsia, Chang, Chen, and Sheng, (2003)³² reported that in the hemiglossectomy group, regardless of which flap used, all patients exhibited various difficulties in producing velar stop consonants which might be because of surgical damage to elevators of tongue (styloglossus or palatoglossus). Also, they mentioned that because of the pliability of radial forearm free flaps, better assistance for production of curled consonants can be provided.

2. Aim of the study

To investigate the articulatory functions of patients who have undergone tongue reconstruction following hemiglossectomy.

To compare the speech intelligibility between hemiglossectomy patients who have undergone tongue reconstruction using pectoralis major myocutaneous with those hemiglossectomy patients who had undergone tongue reconstruction using radial forearm free flap.

3. Materials and Methods

3.1. Participants

Fourteen patients who have undergone tongue reconstruction following hemiglossectomy as a treatment for oral cancer between the age of 30 to 60 years were taken up for this study. Nine of the patients were male and one of them was female. All the patients had Tamil as their native language. Among these patients, seven patients have undergone reconstruction of tongue with pectoralis major myocutaneous flap and seven patients have undergone tongue reconstruction with free radial forearm flap following hemiglossectomy.

3.2. Investigation of articulation characteristics

For assessing the articulatory functions of patients, Tamil Articulation Test was used. The words which consists of the target phoneme were presented by the investigator and the patients were asked to repeat the words. Each patient's speech sample was transcribed in International Phonetic Alphabet by the investigator. The transcription of each word was denoted as correct or incorrect production of target phoneme. If incorrect, further it was analyzed for place and manner of error production.

3.3. Evaluation of speech intelligibility

The speech intelligibility of each patient was assessed using the Ali Yavar Jung National Institute for the Hearing Handicapped intelligibility rating scale, which is a seven point rating scale. The patient's spontaneous speech was recorded. The recorded speech samples were given to three speech language pathologist for rating the Speech Intelligibility and then average score was taken.

4. Results

4.1. Articulatory functions

Analysis of articulatory errors in patients who have undergone tongue reconstruction following hemiglossectomy revealed that in place of articulation, linguoalveolar consonants were more impaired when compared to other consonants. In error analysis according to manner of articulation, most commonly distortion errors were observed in stops/ plosives (alveolar, velar) followed by laterals and affricates. In few patients, substitution of vowels for consonants were observed. There were variable position of errors observed but predominantly initial position errors were observed more commonly than medial and final position.

4.2. Speech intelligibility

Ratings of speech intelligibility of the patients using Perceptual Speech Intelligibility rating scale indicated that

on average the rating score was 3.4 with a standard deviation of 0.48 for patients who have undergone reconstruction of tongue with pectoralis major myocutaneous flap and on average the rating score 2.4 with standard deviation of 0.48 for patients who have undergone tongue reconstruction with free radial forearm flap. On Ali Yavar Jung National Institute for the Hearing Handicapped intelligibility rating scale, a score of 2 denotes can understand with little effort, a score of 3 which denotes can understand with concentration and effort, especially by a sympathetic listener. After hemiglossectomy, patients with free radial forearm flap reconstruction had somewhat better speech intelligibility than patients with pectoralis major myocutaneous flap reconstruction.

5. Discussion

This study investigated the articulation functions of patients who have undergone tongue reconstruction following hemiglossectomy. The articulatory function evaluation revealed that linguoalveolar consonants were found to be more affected. Since the production of linguoalveolar consonants requires the contact of tongue tip with the alveolar ridge, in patients who have undergone tongue reconstruction following hemiglossectomy there was restricted tongue mobility and flexibility in order to contact the alveolar ridge. These results are in agreement with the studies done by Jaya et al (2016);²⁶ Burtet et al (2020).²⁷ For the production of plosives and affricative sounds, a valve should be created for the sudden burst of air in the vocal tract by the tongue when it touches the palate.³² In our study, distortion errors were found in stops/ plosives (alveolar, velar), laterals, and affricates because of inadequate tongue elevation.

The second objective of the study was to determine if there is any difference in the speech intelligibility between hemiglossectomy patients who have undergone tongue reconstruction using pectoralis major myocutaneous flap and radial forearm free flap. Average rating scores revealed that among the patients who have undergone tongue reconstruction following hemiglossectomy, patients with radial forearm free flap had somewhat better speech intelligibility compared to patients with pectoralis major myocutaneous flap reconstruction. This result receives support from the study done by Su, Chen, and Sheng (2002)³³ who reported that patients with radial forearm flap had better speech intelligibility than pectoralis major flap transfer. The results of the present study are also in congruence with the findings by Su et al (2003)³² who compared the abilities of radial forearm free flap and pectoralis major flap to reserve the function of tongue and reported that patients with the free flap reconstruction had more intelligibility of speech.

6. Conclusion

This study was designed primarily to highlights the articulatory functions of patients who have undergone tongue reconstruction following hemiglossectomy. Also, the type of reconstruction impacts the speech intelligibility. Effective intervention can be planned based on the comprehensive speech evaluation and analysis of articulatory error relative to place and manner of production.

7. Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

8. Source of Funding

None.

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