

The treatment option for cancers of the tongue is glossectomy, which may be partial, sub-total, or total, depending on the size of the tumour. Glossectomies result in speech deficits for these patients, and rehabilitative therapy involving communication modalities is highly recommended. Sign language is a possible therapeutic solution for post-glossectomy oral cancer patients. Patients with tongue cancers who have undergone total glossectomy as a surgical treatment can utilise sign language to replace their loss of speech production and maintain their engagement in life. This manuscript emphasises the importance of sign language in rehabilitation strategies in post-glossectomy patients.

Key words: tongue, cancer, glossectomy, sign language, rehabilitation.

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Post-glossectomy in lingual carcinomas: a scope for sign language in rehabilitation

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Introduction

Oral cancers are the seventh most common cancer of the body. Among the oral cancers, squamous cell carcinoma is the most common. Squamous cell carcinoma can affect the lips, cheek mucosa, tongue, palate or teeth-bearing alveolar segment, and gums. Cancers like squamous cell carcinoma are widely treated with the surgical option of excision of the involved tissue. In instances of cancer of the tongue, the affected tongue areas are excised and this results in compromising the speech skills of these patients. Communication therapy is highly recommended for these individuals.

Speech has an oral-aural mode because it is orally produced and aurally perceived. Having lost the ability to speak, these patients often resort to note writing or pantomime to express themselves. Sign language, given its visual-gestural modality, is ideal as a means of communication for persons who cannot produce speech. Post-glossectomy patients can perceive speech auditorily and respond using signs to produce the same level of lexical and grammatical complexity found in speech.

The aim of this review is to propose sign language as a communication solution for post-glossectomy oral cancer patients. The focal point of this article is to show how patients with tongue cancers who have undergone total glossectomy as a surgical treatment can use sign language to replace their loss of speech production.

Literature review

A literature search for glossectomy procedures on tongue cancer cases was conducted in the PubMed database using the Medical Subject Heading (MeSH) term “glossectomy and tongue cancer” from the late 1980s to 2015. Four hundred and thirty-one research papers were found. The inclusion criteria were: 1) free full-text availability, 2) English language, and 3) glossectomy, tongue cancer and speech difficulty. The exclusion criteria were duplicated titles, and incorrect web-link for full text accessibility. These criteria resulted in 39 free full text papers being included (Fig. 1). The study designs, titles, abstracts, results and discussions in the 39 research papers were reviewed. Following this review, 24 research papers were excluded due to lack of information on speech difficulty. The review process yielded 15 research papers which have been considered in the present paper that satisfied the inclusion criteria (Table 1).

Luna Ortiz *et al.* reported that speech difficulties in tongue cancer patients are related to the size of the tumour [1]. Slurred speech is also reported in tongue cancer patients [2]. Murano *et al.* in 2010 reported that post-partial glossectomy with selective neck dissection resulted in numbness of the tongue, but no swallowing or speech problems [3]. Research results on

Table 1. Summary of case report and research studies on speech difficulty in glossectomy patients

Author	Tongue cancer type	Glossectomy and other treatment details	Number of study population	Design/ Reporting country	Reporting speciality	Results/ comments
Chung <i>et al.</i> 2015 [18]	Lingual tumour	Partial glossectomy	1285	Research study, United States	Otolaryn-gology	Speech difficulty not reported
Saxena <i>et al.</i> 1970 [19]	Lingual carcinomas	Radiotherapy, subsequent surgery and radiotherapy	456	Research study, Canada	Radiation therapy	Speech difficulty not reported
Toshifumi <i>et al.</i> 2013 [20]	Squamous cell carcinoma of the tongue (Clinical stage I and II)	Partial glossectomy	365	Research study, Japan	Head and neck surgery	Speech difficulty not reported
Mizuo <i>et al.</i> 2009 [21]	Squamous cell carcinoma of the tongue	Glossectomy	248	Research study, Tokyo	Head and neck surgery	Speech difficulty not reported
Ganly <i>et al.</i> 2013 [22]	Squamous cell carcinoma of the tongue	Partial glossectomy and neck dissection without postoperative radiation	164	Research study, United States	Head and neck surgery	Speech difficulty not reported
Parikh <i>et al.</i> 1998 [6]	Squamous cell carcinoma of the tongue	Hemiglossectomy or total glossectomy	126	Research study, India	Head and neck surgery	1. Glossectomy procedures have considerable speech difficulties 2. No difference in the quality of speech between the two types of surgery
Urashima <i>et al.</i> 2006 [23]	Squamous cell carcinoma in 108 patients, Muco-epidermoid carcinoma in 2 patients, Adenoid cystic carcinoma in 1 patient	Brachytherapy with or without chemotherapy and radiotherapy	111	Research study, Japan	Clinical radiology	Speech difficulty not reported
Halczy-Kowalik <i>et al.</i> 2012 [7]	Lingual tumour	Hemi/partial/total-glossectomy	95	Research study/Poland	Post-operative rehabilitation in oral and maxillofacial surgery	Reconstruction of the tongue mass after a hemiglossectomy may be beneficial for the act of swallowing and detrimental for speech generation because of the limited mobility of the remaining part of the tongue
Akhtar <i>et al.</i> 2007 [24]	Squamous cell carcinoma of the tongue	Partial glossectomy and an elective modified radical neck dissection	94	Research study, Pakistan	Otolaryngology	Speech difficulty not reported
Ikram <i>et al.</i> 2006 [25]	Squamous cell carcinoma of the tongue	Hemiglossectomy with or without neck dissection and radiotherapy	80	Research study, Pakistan	Otolaryngology	Speech difficulty not reported
Habu <i>et al.</i> 2015) 26)	Oral squamous cell carcinoma (Clinical stage I and II)	Partial glossectomy	50	Research study, Tokyo	Otorhino-laryngology	Speech difficulty not reported
López <i>et al.</i> 2004 [27]	Squamous cell carcinoma of the tongue	Glossectomy	46	Research study, United States	Pathology	Speech difficulty not reported
Shiga <i>et al.</i> 2012 [28]	Squamous cell carcinoma of the tongue (42 patients) and Verrucous carcinoma of the tongue (1 patient)	T1 cancer was treated with partial glossectomy with or without neck dissection. Late T2N0 tumours were treated with Supra-Omohyoid neck dissection. Recurrent tumour	43	Research study, Japan	Otolaryngology	Speech difficulty not reported

Table 1. Cont.

Author	Tongue cancer type	Glossectomy and other treatment details	Number of study population	Design/ Reporting country	Reporting speciality	Results/ comments
		with no prior neck dissection at first surgery an additional surgery with neck dissection was done. When surgery was not possible, radiotherapy and chemotherapy were recommended				
Tarsitano <i>et al.</i> 2013 [8]	Lingual tumour	Hemiglossectomy, chemotherapy and radiotherapy	26	Research study, Italy	Oral and maxillofacial surgery	No significant differences were seen for speech intelligibility or quality of life between free radial forearm flap and anterolateral thigh flap
Bachher <i>et al.</i> 2002 [11]	Lingual tumour	Partial glossectomy	25	Research study, India	Speech-language pathology	1. Voice quality and resonance are compromised after surgery because of changes in oral cavity volume 2. Articulation is affected because the tongue is unable to assume the normal position to provide valuing action needed for precise articulation 3. The larger the segment of the tongue, the greater is the distortion of speech
Pugazhendi <i>et al.</i> 2012 [29]	Squamous cell carcinoma of the tongue (Clinical stage I and II)	Glossectomy with and without neck dissection	21	Research study, India	Oral and maxillofacial surgery	Speech difficulty not reported
Sargis <i>et al.</i> 2015 [12]	Squamous cell carcinoma of the tongue	Glossectomy with lingual lymph node removal	21	Research study, Moscow	Oral and maxillofacial surgery	Speech is believed to be determined by variables as the extent and the site of resection
Pons <i>et al.</i> 2009 [30]	Squamous cell carcinoma of the tongue	Partial glossectomy	18	Research study, France	Head and neck surgery	Speech difficulty not reported
Saito <i>et al.</i> 1999 [31]	Lingual tumour	Glossectomy	16	Research study, Japan	Anesthesia	Speech difficulty not reported
Urashima <i>et al.</i> 2006 [23]	Squamous cell carcinoma of the tongue	Glossectomy	10	Research study, Japan	Oral and maxillofacial surgery	Speech difficulty not reported
Stone <i>et al.</i> 2014 [13]	Lingual tumour	Partial glossectomy (Lateral tongue)	10	Research study, United States	Neural and pain science	In glossectomy patients, slight differences in tumour size do not create significant differences in ability to produce speech gestures
Stone <i>et al.</i> 2014 [14]	Squamous cell carcinoma of the tongue	Partial glossectomy	3	Research study, United States	Dental	Patients would have limited motion on the tumour (resected) side and would compensate with greater motion on the non-tumour side in order to elevate the tongue tip and blade
Bell <i>et al.</i> 2009 [2]	Colonic-type adenocarcinomas of the base of the tongue	Total glossectomy with neck dissection (Unilateral/ Bilateral)	2	Case report, United States	Pathology	One patient had slurred speech as an oral complaint while having cancer
Esamti <i>et al.</i> 2015 [32]	Poorly differentiated neuroendocrine carcinoma	Partial glossectomy, chemotherapy and chemoradiation	1	Case report, Iran	Radiation oncology	Speech difficulty not reported

Table 1. Cont.

Author	Tongue cancer type	Glossectomy and other treatment details	Number of study population	Design/ Reporting country	Reporting speciality	Results/ comments
Tanaka <i>et al.</i> 2014 [33]	Squamous cell carcinoma of the tongue	Partial glossectomy and left selective neck dissection	1	Case report, Japan	Otolaryngology	Speech difficulty not reported
Abrari <i>et al.</i> 2014 [34]	Solitary Fibrous tumour	Partial glossectomy	1	Case report, India	Histopathology	Speech difficulty not reported
Preetam <i>et al.</i> 2013) [35]	Tongue carcinoma	hemiglossectomy and supraomohyoid dissection	1	Case study, India	Otorhinolaryngology	Speech difficulty not reported
Crede <i>et al.</i> 2012 [36]	Squamous cell carcinoma of the tongue	Partial glossectomy with microvascular reconstruction	1	Case report, Pakistan	Oral and maxillofacial surgery	Speech difficulty not reported
Irfan <i>et al.</i> 2011 [37]	Squamous cell carcinoma of the tongue	Partial glossectomy	1	Case report, Malaysia	Otorhinolaryngology	Speech difficulty not reported
Deshmukh <i>et al.</i> 2011 [38]	Squamous cell carcinoma of the tongue (T1, N3 and M0)	Partial glossectomy with bilateral modified neck dissection was performed	1	Case report, India	Pathology	Speech difficulty not reported
McNamara <i>et al.</i> 2011 [39]	Hemangioma	Partial glossectomy	1	Case report, United Kingdom	Otolaryngology	Speech difficulty not reported
Bhojraj <i>et al.</i> 2008 [40]	Primary malignant ulcer on the tongue	Glossectomy with reconstruction	1	Case report, India	Cardiac anaesthesia	Speech difficulty not reported
Murano <i>et al.</i> 2010 [3]	Squamous cell carcinoma of the tongue (T1, N0 and M0)	Partial glossectomy with selective neck dissection	1	Case report, United States	Neural and pain sciences	After surgery, the patient reported numbness of the right tongue, but no swallowing or speech problems
Mazeron <i>et al.</i> 2013 [4]	Isolated tongue metastasis of renal clear cell carcinoma	Brachytherapy	1	Case study, France	Brachytherapy	Brachytherapy limits the target volume as compared to external beam radiation, better protecting the organ involved in speech
Unsworth <i>et al.</i> 2013 [9]	Squamous cell carcinoma of the tongue	Partial glossectomy with microvascular reconstruction	1	Case report, United Kingdom	Medicine	Good oral function (speech and swallowing) was restored within 2 weeks
Tasker <i>et al.</i> 2005 [5]	Giant cavernous hemangioma of tongue	Total glossectomy	1	Case report, United Kingdom	Emergency medicine	Patient post-operative progress was extremely good and at discharge had intelligible speech
Kies <i>et al.</i> 2012 [15]	Squamous cell carcinoma of the tongue	Chemotherapy followed by glossectomy and neck dissection and/or radiotherapy and chemotherapy	1	Research study, United States	Thoracic/ head and neck medical oncology	Patients underwent a standardized speech and swallowing evaluation before induction chemotherapy and after induction chemotherapy prior to surgical resection
Tuhar <i>et al.</i> 2015 [10]	Lingual tumour	Total glossectomy	1	Case report, Romania	Plastic surgery and reconstructive microsurgery	Reconstruction with free flaps is feasible method of restoring speech
Luna Ortiz <i>et al.</i> 2008 [1]	Adenoid cystic carcinoma of the tongue (Grade III)	Total glossectomy with reconstruction	1	Case report, Mexico	Head and neck surgery	Speech difficulty due to the size of the tumour

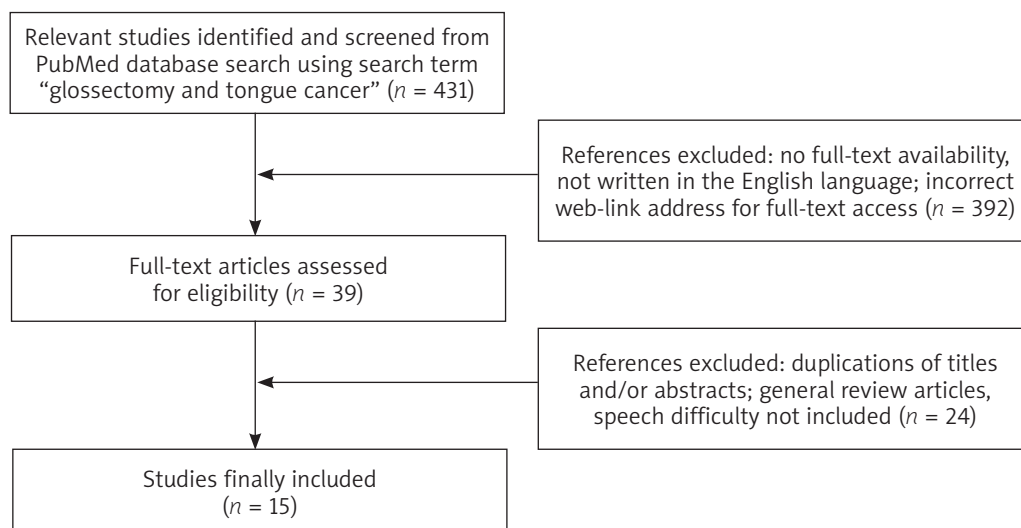


Fig. 1. Flow chart of study selection based on the inclusion and exclusion criteria

brachytherapy in tongue cancer patients mentioned that brachytherapy can limit the target volume as compared to external beam radiation, thus protecting the organ involved in speech [4]. Tasker *et al.* in 2005 reported a case of a total glossectomy (sparing the base of the tongue) procedure on giant haemangioma of the tongue and mentioned that the post-operative progress of the patient was good and that the patient had intelligible speech when they were discharged [5].

Parikh *et al.* in 1998 compared hemi-glossectomy and total glossectomy procedures on tongue cancer patients and reported a direct relationship between glossectomy procedures and considerable speech difficulties. However, there was absolutely no difference in the quality of speech between both types of surgery [6]. In the published report of Halczy-Kowalik *et al.* in 2012 it was mentioned that reconstruction of the tongue mass after a hemi-glossectomy (i.e. where the tongue is resected lengthwise) may be beneficial for the act of swallowing but detrimental for speech generation because of the limited mobility of the remaining part of the tongue [7]. Tarsitano *et al.* in 2013 compared functional results of micro-vascular free radial and antero-lateral flap surgical procedures following hemi-glossectomy in metastatic tongue cancer patients and reported that no significant differences were seen for speech intelligibility or quality of life between the two surgical-flap procedures [8]. A possible explanation of these results could be that a thinner and more pliable flap, such as FRFF, may restore speech articulation more easily than ALTF. Both more extensive surgical resection (pelvectomy) and adjuvant radiotherapy are factors predictive of worse speech intelligibility recovery. Unsworth *et al.* in 2013 also mentioned that partial glossectomy with micro-vascular reconstruction procedure in tongue cancer patients helped with oral functions (i.e. speech and swallowing) in the early healing period [9]. Similarly, Tuhar *et al.* reported that total glossectomy procedures with reconstruction flap surgery performed on advanced cancer patients was

a feasible method of restoring speech [10]. The use of free flaps in the immediate reconstruction of the tongue after tumour resection should aim at the maintenance of the mobility of the residual tongue and restoration of tongue bulk in order to optimise the recovery of speech and swallowing function.

Bachher *et al.* evaluated effective rehabilitation approaches following partial glossectomy procedures and reported that voice quality and resonance are compromised because of a change in oral cavity volume. Articulation is affected because the tongue is unable to assume the normal position to provide valuing action needed for precise articulation. Further to this, the larger the segment of the tongue resected, the greater is the distortion of speech [11]. Sargis *et al.* stated that speech is believed to be determined by variables such as the extent and site of the resection in the glossectomy procedure. In other words, slight differences in tumour size dissection do not create significant differences in ability to produce speech gestures [12]. However, glossectomy patients have limited motion on the tumour-resected side and they compensate for this with greater motion on the non-tumour side in order to elevate the tongue tip [13, 14]. Kies *et al.* mentioned that glossectomy patients underwent a standardised speech and swallowing evaluation before induction chemotherapy and after induction chemotherapy prior to surgical resection of the tongue, and the results were associated with excellent prognosis [15].

Post-glossectomy oral cancer and speech difficulties

Glossectomy is the surgical removal of the tongue, and it is categorised into two types, namely partial and total. Partial glossectomy is the surgical removal of the anterior two-thirds of tongue. In total glossectomy the entire tongue is surgically removed. Glossectomy is the primary treatment option for oral cancer patients with tongue involvement [41].

The tongue is central to the production of vowels and consonants, and the tongue volume helps to maintain resonance. The tongue and lips modulate the production of vowels or consonants due to the capacity of the oral cavity to modify its size and shape. The final speech utterance is produced through a partially or totally occluded oral cavity [42]. Any abnormality in the oral cavity will result in speech dysfunction. Total or partial removal of the tongue will result in speech articulation difficulties as well as changes in resonance [11]. Speech dysfunction may also be identified in post-surgical oral cancer cases of the tongue, floor of mouth, and soft/hard palate. Disruption of the tongue or other oral structures that are involved in speech production and articulation by a tumour or surgical intervention will affect speech intelligibility and affect patient's quality of life [8].

Speech dysfunction following glossectomy is dependent on factors such as extent of surgical resection, tumour stage, tumour site, and extent of severity of damage to tongue muscles during surgical procedure. Additional post-glossectomy complaints may include slurring of speech, gradual loss of speech, stigma or speech impediment [43].

Treatment modalities involved in post-glossectomy treatment are speech therapy, mouth and tongue stretching exercises, muscle compensation/strengthening exercises, and tongue reconstruction [44]. Post-glossectomy mouth and tongue stretching exercises, and muscle compensation exercises aid the patient by strengthening the tongue's muscles towards regaining some of the movement lost due to the glossectomy [45]. The use of maxillary prostheses aids this process as they replace hard structures like the palate and thus give the tongue a firm surface against which to produce sounds [16].

Larger surgical defect areas are usually reconstructed with flap/graft to restore normal function [46]. The effect on the intelligibility and quality of speech was more pronounced in these surgically reconstructed cases due to the reduced extensibility of the grafted tissue which may lead to decreased tongue mobility. However, additional surgical reconstruction can reverse this to a large extent.

Pre- and post-glossectomy visits to the speech pathologist are mandatory in all modalities as the Post-Glossectomy Patient (PGP) has to be re-taught the basic rudiments of speech, and once taught, they have to practice repeatedly to try and re-develop proper speech patterns. For some patients, speech therapy started 4 months after radiation treatment, and one reported that they "hit a plateau in [their] progression". Sign language as a treatment option would decrease the plateau effect by giving them another method of communication and decreasing their total reliance on speech. Speech therapists, who are not themselves fluent in sign language, can work alongside a sign linguist or a sign language teacher to include the use of sign language in therapy. This would facilitate sign language acquisition by the patient.

Despite participating in speech therapy, patients still suffer from psychological conditions caused by their loss of speech, and many report that they are more self-conscious about their post-glossectomy appearance, especial-

ly where it has altered their facial appearance. One such patient reported being very self-conscious, and that knowing "people were staring at them in public" made them even more nervous. The sum effect is that these patients have lower self-esteem due to the resulting speech impediments.

In all modalities, use of a sign language is being recommended as an additional post-treatment solution for post-glossectomy patients as it will give these patients a language that they can use daily without fatigue, decrease their sole dependency on using their tongue to communicate, and it may increase their self-confidence and self-esteem. Self-confidence may increase as they do not have to communicate solely with their tongue, thus decreasing the focus on their speech difficulty by others, and thus they would be less self-conscious of their speech challenges, especially during their speech therapy phase. If at the end of the speech therapy phase they still have difficulty speaking, they can rely more on signing for communication. There can be a greater chance of fluency if sign language lessons are started once the decision to undergo the glossectomy treatment is taken. The post-glossectomy patient would be able to learn the rudiments of the language before the surgery is performed and thus be able to communicate immediately after the surgery without having to revert to written communication.

Sign language as a rehabilitation tool

A glossectomy changes the linguistic identity of a patient from oral and hearing to dysarthric and hearing for partial glossectomy patients, or mute and hearing for total glossectomy patients. This shift requires holistic pre-glossectomy preparation and support. The partial glossectomy patient would require speech therapy and may adopt a sign language as a supplemental or secondary means of communication. For the total glossectomy patient, the surgeon, psychologist and social worker should assist the patient in planning for life as a mute. This plan must include sign language acquisition which ideally would begin as soon as glossectomy is added to the treatment plan. The patient should then have sign language classes and become a member of the local Deaf community. This approach challenges the health care team to transition from a medical/pathological view of deafness to a cultural/anthropological view. This latter view acknowledges the existence of a culture with an identity of having a visual-gestural language as its primary means of communication [47].

It may be challenging to acquire a language, particularly one in a different modality, as an adult or at the stage of life in which the patient finds himself [48]. The best teacher of a language is a native user of that language. Thus, the starting point for sign language classes should be local deaf organisations. If none are available, the patient can check schools for the deaf and religious organisations for sign language classes. Some universities offer sign language courses and programmes. If one is uninterested in an entire university programme, one may be able to audit a course or be specially admitted for a specific course.

Members of the family or primary home support network should also learn sign language, preferably at the same time as the patient. Together, the patient and his family or support network must create a post-glossectomy communication plan. This plan would outline or detail the settings and communicative events in which speech and sign language would be used. Creating this plan would assist everyone involved in making a mental shift toward the impending speech disorder [17].

Conclusions

Post-glossectomy oral cancer patients who incorporate learning sign language in their rehabilitation are able to compensate for their speech loss, communicate more easily, improve their self-esteem, and have a higher quality of life. Oral cancer patients who undergo glossectomies require speech rehabilitation procedures to maintain interpersonal communication because of the role of speech in social interaction. Any impairment in speech may lead to marginalisation due to social stigmas.

Sign language acts as an adjunct method of communication rehabilitation in post-glossectomy patients. In the post-operative period, compromised tongue tissue causes a reduction in the ability of patients to manipulate the tongue for well-formed phonetic articulation. The speech therapist and sign linguist can work together to create both a sign language learning plan for the patient and a communication plan that incorporates their understanding of speech with their use of sign language.

Communicating is critical to survival and a high quality of life. Whilst post-treatment speech rehabilitation may not lead to functional or complete restoration of speech, sign language as a communication method can be a tool to optimise the patient's quality of life. The incorporation of sign language use in the management of the glossectomy patient would be a novel and important step in the new drive towards comprehensive management of surgical patients.

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References

- Luna Ortiz K, Carmona Luna T, Herrera Gomez A, Cano Valdez AM. Macroglossia caused by adenoid cystic carcinoma. Case report. *Med Oral Patol Oral Cir Bucal* 2008; 13: E395-7.
- Bell D, Kupferman ME, Williams MD, Rashid A, El-Naggar AK. Primary colonic-type adenocarcinoma of the base of the tongue: a previously unreported phenotype. *Human Pathol* 2009; 40: 1798-802.
- Murano EZ, Shinagawa H, Zhuo J, Gullapalli RP, Ord RA, Prince JL, et al. Application of diffusion tensor imaging after glossectomy. *Otolaryngol Head Neck Surg* 2010; 143: 304-6.
- Mazeron R, Fenoll L, Mathieu MC, Dumas I, Haie-Meder C. Brachytherapy for isolated tongue metastasis of renal clear cell carcinoma. *Eur Ann Otorhinolaryngol Head Neck Dis* 2013; 130: 149-51.
- Tasker LJ, Geoghegan J. Giant cavernous haemangioma of the tongue. *Anaesthesia* 2005; 60: 1043.
- Parikh HK, Rao RS, Sukthankar P, Deshmane VH, Parikh DM. Surgery in early cancer of the oral tongue (T1-2). Wide excision versus hemiglossectomy. *Indian J Otolaryngol Head Neck Surg* 1998; 50: 349-53.
- Halczy-Kowalik L, Sulikowski M, Wysocki R, Posio V, Kowalczyk R, Rzewuska A. The role of the epiglottis in the swallow process after a partial or total glossectomy due to a neoplasm. *Dysphagia* 2012; 27: 20-31.
- Tarsitano A, Vietti MV, Cipriani R, Marchetti C. Functional results of microvascular reconstruction after hemiglossectomy: free anterolateral thigh flap versus free forearm flap. *Acta Otorhinolaryngol Ital* 2013; 33: 374-9.
- Unsworth JD, Baldwin A, Byrd L. Systemic lupus erythematosus, pregnancy and carcinoma of the tongue. *BMJ Case Rep* 2013; 2013: pii: bcr2013008864.
- Tuhar, Zamfirescu D, Gheorghita C, Slavescu D, Frunza A, Lascar I. Ablation of advanced tongue cancer and mobile tongue reconstruction by using a sensitive anterolateral thigh and vastus lateralis muscle free flap. *J Med Life* 2015; 8: 64-7.
- Bachher GK, Dholam K, Pai PS. Effective rehabilitation after partial glossectomy. *Indian J Otolaryngol Head Neck Surg* 2002; 54: 39-43.
- Ananian SG, Gvetadze SR, Ilkaev KD, Mochalnikova VV, Zayratiants GO, Mkhitarov VA, Yang X, Ciciashvili AM. Anatomic-histologic study of the floor of the mouth: the lingual lymph nodes. *Jpn J Clin Oncol* 2015; 45: 547-54.
- Stone M, Langguth JM, Woo J, Chen H, Prince JL. Tongue motion patterns in post-glossectomy and typical speakers: a principal components analysis. *J Speech Lang Hear Res* 2014; 57: 707-17.
- Stone M, Woo J, Zhuo J, Chen H, Prince JL. Patterns of variance in /s/ during normal and glossectomy speech. *Comput Methods Biomech Biomed Eng Imaging Vis* 2014; 2: 197-207.
- Kies MS, Boatright DH, Li G, Blumenschein G, El-Naggar AK, Brandon Gunn G, et al. Phase II trial of induction chemotherapy followed by surgery for squamous cell carcinoma of the oral tongue in young adults. *Head Neck* 2012; 34: 1255-62.
- Vieira CA. Speech therapy in total glossectomy – case study. *Rev Soc Bras Fonoaudiol* 2011; 16: 4.
- KC. Caribbean Sign Language for Dentistry: A Guide to Communicating with Deaf Patients for Dental Practitioners. HIS Publishing; Tacarigua: 2014.
- Chung TK, Rosenthal EL, Magnuson JS, Carroll WR. Transoral robotic surgery for oropharyngeal and tongue cancer in the United States. *Laryngoscope* 2015; 125: 140-5.
- Saxena VS. Cancer of the tongue: local control of the primary. *Cancer*. 1970; 26: 788-94.
- Tomioka T, Hayashi R, Ebihara M, Miyazaki M, Shinozaki T, Fujii S. Observation as an option for epithelial positive margin after partial glossectomy in stage I and II squamous cell carcinoma: analysis of 365 cases. *Jpn J Clin Oncol* 2013; 43: 520-3.
- Ando M, Asai M, Asakage T, Oyama W, Saikawa M, Yamazaki M, et al. Metastatic neck disease beyond the limits of a neck dissection: attention to the 'para-hyoid' area in T1/2 oral tongue cancer. *Jpn J Clin Oncol* 2009; 39: 231-6.
- Ganly I, Goldstein D, Carlson DL, et al. Long-term regional control and survival in patients with "low-risk," early stage oral tongue cancer managed by partial glossectomy and neck dissection without postoperative radiation: the importance of tumor thickness. *Cancer* 2013; 119: 1168-76.
- Urashima Y, Nakamura K, Kunitake N, Shioyama Y, Sasaki T, Ooga S, et al. Is glossectomy necessary for late nodal metastases without clinical local recurrence after initial brachytherapy for N0 tongue cancer? A retrospective experience in 111 patients who received salvage therapy for cervical failure. *Jpn J Clin Oncol* 2006; 36: 3-6.
- Akhtar S, Ikram M, Ghaffar S. Neck involvement in early carcinoma of tongue. Is elective neck dissection warranted? *J Pak Med Assoc* 2007; 57: 305-7.
- Ikram M, Jafferbhoy SF, Onali MA. Neck recurrence in early carcinoma tongue. *J Pak Med Assoc* 2006; 56: 448-51.
- Habu N, Imanishi Y, Kameyama K, Shimoda M, Tokumaru Y, Sakamoto K, et al. Expression of Oct3/4 and Nanog in the head and neck squamous carcinoma cells and its clinical implications for delayed neck metastasis in stage I/II oral tongue squamous cell carcinoma. *BMC Cancer* 2015; 15: 730.

27. Lopez de Cicco R, Watson JC, Bassi DE, Litwin S, Klein-Szanto AJ. Simultaneous expression of furin and vascular endothelial growth factor in human oral tongue squamous cell carcinoma progression. *Clin Cancer Res* 2004; 10: 4480-8.
28. Shiga K, Ogawa T, Sagai S, Kato K, Kobayashi T. Management of the patients with early stage oral tongue cancers. *Tohoku J Exp Med* 2007; 212: 389-96.
29. Pugazhendhi SK, Thambiah L, Venkatesetty A, Thangaswamy V. Elective neck dissection versus “wait and watch” policy in tongue carcinoma. *J Pharm Bioallied Sci* 2012; 4 (Suppl 2): S226-9.
30. Pons Y, Gauthier J, Clement P, Conessa C. Ultrasonic partial glossectomy. *Head Neck Oncol* 2009; 1: 21.
31. Saito T, Den S, Hiraga K, Uchiyama K, Carlsson C. The difference between delayed extubation and tracheostomy in post-operative sleep apnea after glossectomy or laryngectomy. *Jpn J Clin Oncol* 1999; 29: 127-31.
32. Esmati E, Babaei M, Matini A, Ashtiani MS, Hamed EA, Nosrati H, et al. Neuroendocrine carcinoma of the tongue. *J Cancer Res Ther* 2015; 11: 659.
33. Tanaka Y, Tomifuji M, Suzuki H, Yamashita T, Araki K, Shiotani A. Transoral videolaryngoscopic surgery with a navigation system for excision of a metastatic retropharyngeal lymph node. *ORL J Otorhinolaryngol Relat Spec* 2014; 76: 357-63.
34. Abrari A, Bakshi V. Solitary fibrous tumour (SFT) of the residual tongue, post partial glossectomy for carcinoma. *Ind J Pathol Microbiol* 2014; 57: 648-50.
35. Preetam C, Sikka K, Kumar R, Kumar R. Always expect the unexpected – chyle leak: revisiting the entity. *Indian J Cancer* 2013; 50: 8.
36. Crede A, Locher M, Bredell M. Tongue cancer in young patients: case report of a 26-year-old patient. *Head Neck Oncol* 2012; 4: 20.
37. Irfan M, Aliyu YA, Baharudin A, Shahid H. Harmonic scalpel for a bloodless partial glossectomy: a case report. *Med J Malaysia* 2011; 66: 148-9.
38. Deshmukh M, Bal M, Deshpande P, Jambhekar NA. Synchronous squamous cell carcinoma of tongue and unicentric cervical Castleman’s disease clinically mimicking a stage IV disease: a rare association or coincidence? *Head Neck Pathol* 2011; 5: 180-3.
39. McNamara K, Olaleye O, Smith J, Karamchandani D, Watkinson J. A rare case of a concurrent large thyroglossal duct cyst with a base of tongue haemangioma. *BMJ Case Rep* 2011; 2011: pii: bcr1020103393.
40. Bhojraj S, Jain S, Hamdulay Z, Kumar P, Ali M, Pradhan S. Simultaneous off-pump coronary artery bypass graft surgery and wide glossectomy. *Ann Card Anaesth* 2008; 11: 46-8.
41. Ow TJ, Myers JN. Current management of advanced resectable oral cavity squamous cell carcinoma. *Clin Exp Otorhinolaryngol* 2011; 4: 1-10.
42. Laver J. The architecture of phonetic classification. *Principles of Phonetics*. Cambridge University Press, Cambridge 1994; 119-58.
43. Chuanjun C, Zhiyuan Z, Shaopu G, Xinquan J, Zhihong Z. Speech after partial glossectomy: a comparison between reconstruction and nonreconstruction patients. *J Oral Maxillofac Surg* 2002; 60: 404-7.
44. Pauloski BR. Rehabilitation of Dysphagia Following Head and Neck Cancer. *Phys Med Rehabil Clin N Am* 2008; 19: 889-928.
45. Furia CL, Kowalski LP, Latorre MR, Angelis EC, Martins NM, Barros AP, Ribeiro KC. Speech intelligibility after glossectomy and speech rehabilitation. *Arch Otolaryngol Head Neck Surg* 2001; 127: 877-883.
46. Mazarro A, de Pablo A, Puiggròs C, Velasco MM, Saez M, Pamias J, Bescós C. Indications, reconstructive techniques, and results for total glossectomy. *Head Neck* 2016; 38 (Suppl 1): E2004-10.
47. Cumberbatch K. Deaf culture. *Caribbean Sign Language for Dentistry: A Guide to Communicating with Deaf Patients for Dentists*. HIS Publications: Tacarigua, 2014. E-book with Film.
48. McKee RL, McKee D. What’s so Hard about learning ASL?: students’ and teachers’ perceptions. *Sign Language Studies* 1992; 75: 129-58.

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