



## Review

# Speech and swallowing following tongue cancer surgery and free flap reconstruction – A systematic review

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## SUMMARY

This was a systematic review of the current research on speech and swallowing outcomes and the factors affecting these outcomes after primary resection of tongue cancer and free flap reconstruction. A structured search in various electronic databases and relevant journals was performed. Retrieved articles were critically appraised in three rounds according to the level of evidence, the methodological quality, and the specific domain of speech and swallowing. A total of 21 articles were in the final review and the findings were categorized according to the area of tongue resection. For patients with resection and free flap reconstruction limited to either the oral tongue or the base of tongue (BOT), significant decline in speech and swallowing function was evident in the early postoperative phase, but the majority recovered close to preoperative level after 1 year. Poorer speech and swallowing outcomes were found following resections involving both oral and base of tongue (OBOT) regardless of the type of free flap reconstruction. Results overall were influenced by multiple factors including tumor size, area of resection, method of reconstruction and the use of adjuvant therapy. The use of free flaps in the immediate reconstruction of the tongue after tumor resection should aim at the maintenance of the mobility of the residual tongue and restoration of tongue bulk in order to optimize the recovery of speech and swallowing function. Future research in this field should employ standardized and reliable evaluation of speech and swallowing outcomes using multiple modalities in well-designed cohort studies with longer follow-up.

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## 1. Introduction

Reconstruction following tongue cancer resection remains one of the most challenging problems in head and neck oncology. The principles of reconstruction traditionally followed a reconstructive ladder; small glossectomy defects may be closed by primary closure, healing by secondary intention, or skin grafts while greater resections necessitate reconstructions with local flaps, pedicled flaps, or free flaps.<sup>1–6</sup> With the success of microvascular surgery, immediate free flap transfer has become the most common and accepted standard of care after tumor ablation.<sup>2,5,7–14</sup>

Successful tongue reconstruction involves more than satisfactory wound healing and flap survival. Increasingly, functional rehabilitation is considered an important outcome following reconstructive surgery.<sup>1,8</sup> Approach to evaluating functional restoration can be divided between the oral tongue and the base of tongue (BOT) owing to the different functions that these two regions serve.<sup>2,15</sup> Mobility of the oral tongue is essential for speech, mastication, oral hygiene, and the oral phase of swallowing.<sup>2</sup> Hence the

goal of reconstruction is to maximize mobility of the residual tongue and to maintain its shape and position within the oral cavity by introducing a thin, pliable flap, such as the radial forearm free flap (RFFF).<sup>2,16</sup> For the BOT, the shape, volume, and mobility are critical factors in completing the pharyngeal phase of swallowing while helping to prevent aspiration.<sup>2,17</sup> When tumor resection involves both oral and base of tongue (OBOT), a wide and thick flap such as the rectus abdominus mucocutaneous free flap (RAMCF) is often used to replace soft tissue bulk.<sup>14,18–20</sup>

The impact of tongue cancer resection and free flap reconstruction on speech and swallowing functions has been evaluated objectively and subjectively in functional outcome studies.<sup>9,21–28</sup> Recent studies have also focused on factors affecting postoperative speech and swallowing, such as the location and extent of resection,<sup>29–34</sup> method of reconstruction,<sup>3,9,11,30,31,35</sup> sensory reinnervation,<sup>9</sup> tongue mobility and volume<sup>1,14,28,36,37</sup> and postoperative radiotherapy (PORT).<sup>26,28</sup>

The purpose of this systematic review is to evaluate current literature on speech and swallowing following immediate free flap tongue reconstruction according to the guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.<sup>38</sup> The research questions were (1) what are the speech and swallowing outcomes of primary resection of tongue cancer and immediate free flap reconstruction with or without

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adjuvant therapy and (2) what factors affect speech and swallowing outcomes in these patients.

## 2. Materials and method

### 2.1. First round search

Studies were identified by searching Pubmed, Ovid, Embase and the Cochrane Library databases. As studies involving tongue cancer are often included with those covering head and neck or oral and oropharyngeal cancers, a broad search was undertaken to identify all possible studies. The following keywords were used: tongue or tongue cancer; surgery or resection; reconstruction; free flap; speech; swallowing; deglutition; functional outcome. The literature search was limited to human studies, English publications and included all dates available. The last date of search was 1st May 2012.

Titles and abstracts of all identified articles were independently screened by two reviewers to determine relevance. For those studies with insufficient data in the title and abstract, the full text articles were obtained and screened. Full texts of all articles relevant to speech and swallowing outcome following tongue cancer surgery and free flap reconstruction were retrieved.

A manual search through the following journals was performed from January 2000 to May 2012: *International Journal of Oral and Maxillofacial Surgery*; *Journal of Oral and Maxillofacial Surgery*; *British Journal of Oral and Maxillofacial Surgery*; *Head and Neck*; *Plastic and Reconstructive Surgery*; *Journal of Cranio-maxillofacial Surgery*; *Otolaryngology Head and Neck Surgery* and *Oral Oncology*. Articles relevant to the research questions were retrieved. Reference lists from all the identified studies were screened for other relevant citations.

### 2.2. Second round search

All relevant articles from the first round were screened independently by two reviewers according to the eligibility criteria (Table 1). The method and time of speech and swallowing evaluations must be clearly reported. In studies where tongue cancer patients are a subgroup of patients or if a combination of reconstructive methods were used, outcomes specific to tongue cancer patients with free flap reconstructions must be clearly reported. Studies were excluded if relevant results could not be extracted. Studies that included recurrent or salvage cases were excluded as they represent a different treatment pathway. Studies that are of opinion-based, only reported outcomes related to survival, toxic effects or general outcome (e.g. anxiety or depression), or focused on or combined functional outcome following primary radiotherapy (RT) or chemotherapy (CT) were also excluded. All studies meeting the eligibility criteria entered the final round. Studies rejected at this or subsequent stages and the reasons for their exclusion were recorded.

**Table 1**  
Eligibility criteria for articles included in the final review.

Type of studies	Research-based studies published in peer-reviewed journals with a minimal sample size of 10 patients
Type of participants	Patients with primary tongue cancer
Type of intervention	Primary tongue cancer resection and immediate free flap reconstruction WITH area of tongue resection (oral tongue only, BOT only, OBOT), the extent of resection (partial, hemi-, subtotal or total glossectomy or percentage of tongue resected), and the type of free flap reconstruction reported
Type of outcome measures	
Primary outcomes	Speech Swallowing
Secondary outcome	Factors affecting speech and swallowing outcomes

BOT = base of tongue, OBOT = oral and base of tongue.

### 2.3. Final round evaluation

Articles in the final round were reviewed independently by two reviewers using a standardized appraisal form. Their level of evidence was graded using the guideline 'The Oxford 2011 Level of Evidence' provided by the Oxford Center for Evidence-Based Medicine (Table 2).<sup>39</sup> In addition, each of the included articles was critically appraised in terms of validity and heterogeneity according to 10 criteria (Table 3).<sup>40–42</sup> An article was classified as having low risk of bias if it met 9 or more criteria; moderate risk of bias if it met 7 or 8 criteria; and high risk of bias if it met less than 7 criteria.

## 3. Results

### 3.1. General findings

A flow diagram of the literature search is presented in Fig. 1. The electronic search yielded 1942 hits from PubMed, 341 hits from Ovid, 39 hits from the Cochrane Library and 275 hits from Embase. After duplicates were removed, title and abstract of 1992 articles were screened, 113 articles were considered relevant to the questions of this review and 1879 articles were excluded. The manual search of the most recent 13 years of the selected journals and the reference lists of all the identified articles yielded additional 3 and 12 relevant articles respectively. Full texts of all 128 articles were reviewed based on the eligibility criteria. One hundred and seven studies failed to meet one or more of the criteria and were excluded with the reasons documented in Table 4. Twenty-one studies entered the final round for critical appraisal.

Level of evidence ratings of the included studies ranged between levels II and IV. There was no systematic review or randomized controlled trials; the majority of studies were case series (Table 5). Of the 21 studies, 10 were prospective<sup>43–52</sup> and 11 were retrospective<sup>14,16,28,30,53–59</sup> studies published between 2002 and 2012. There were 2 multi-center studies from Japan.<sup>30,55</sup> Research

**Table 2**  
The Oxford 2011 Levels of Evidence.<sup>39</sup>

Level	Category of evidence
I	SR (with homogeneity) of RCT Individual RCT
II	SR (with homogeneity) of cohort studies Individual cohort study (including low-quality RCT. For example <80% follow up) 'Outcome' research; ecological studies
III	SR (with homogeneity) of case-control studies Individual case-control study
IV	Case series and poor quality cohort and case-control studies
V	Expert opinion without explicit critical appraisal, or based on physiology, bench research or first principles

SR = systematic review, RCT = randomized controlled trials.

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