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Case Report

Radial Forearm Free Flap for Tongue Reconstruction

Alfonso Iván Sánchez-Terán [*1], Anyely Nataly Fuertes-Muñoz [1], Martha Elena Gutiérrez-Brambila [1], Juan Carlos Luna-Garcia [1], Luis Anibal Cervantes-Ruíz [1], Luis Abraham Zúñiga-Vázquez [2], Gerardo Chávez-Pérez [1]

[1]General Surgery Department, Regional Hospital of High Specialty of Bajío, 37660 León, México.
[2]Surgical Oncology Department, Aranda de la Parra Hospital, 37000 León, México.

*Corresponding author: Alfonso Sánchez-Terán; *alfsnchzt@gmail.com*

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Abstract

A woman in his mid-50s presented with an ulcer on the right side of her tongue associated with sore throat. The lesion progressively grew until it became exophytic. An incisional biopsy showed a well-differentiated squamous cell carcinoma, invasive, ulcerated, p16 positive, with lymphovascular permeation and muscle infiltration so she was referred to a surgical oncologist. There was history of oral sex habits and poor dental hygiene. At physical examination there was a 2.5 x 2 cm neoformation on the right lateral side of the tongue associated with pain, which was mild, intermittent, and localized, the base of the tongue and floor of the mouth were apparently free. The team decided to perform a right hemiglossectomy plus radical neck dissection. Given the anatomical and functional needs of the area, a microvascular reconstruction with a Radial Forearm Free Flap was chosen due to its thinness, flexibility, ease of harvest, and reliability.

Keywords: ***plastic and reconstructive surgery, surgical oncology, head and neck surgery, tongue cancer, radial forearm free flap.***

Introduction

Squamous cell carcinoma (SCC) is the most common tongue cancer worldwide [1]. It originates from the mucosal epithelium, and it is divided into HPV-positive (with the best prognosis) and HPV-negative. Among the premalignant lesions are erythroplakia and leukoplakia. Friction keratosis is not considered a premalignant lesion [2]. The main risk factors are tobacco and/or alcohol consumption (risk >35 times versus general population), HPV and/or EBV infection, oral sex, poor oral hygiene, and environmental contamination. The most common site of tongue cancer is the lateral border of the anterior two-thirds and 75% do not cross the midline.

The definitive management with curative intent is surgery alone or with adjuvant therapy (as indicated by pathologic staging), being the presence of nodal metastasis in the neck the most important prognostic factor [3]. Reconstructive options after tongue resection are largely dependent on the size of the defect after resection, the overall functional status of the patient, the anticipated need for adjuvant treatment modalities, and the hopes of preserving functions of the tongue [4]. Modern reconstructive methods with free flaps allow more extensive resections for locoregional control [5]. The oncological margins recommended are 1.5-2 cm and the types of glossectomy include partial glossectomy (<1/3 of tongue), hemiglossectomy (1/3 to 1/2 of the tongue), subtotal glossectomy (1/2 to 3/4 of the tongue) and total glossectomy (the entire tongue) [6]. The most common disabilities after surgical resection without immediate reconstruction are impaired swallowing and speech in 50%, voice problems at 10 years in 66% and dysphagia at 2 years in 45%. The greater the degree of resection of the tongue, the greater the deterioration of swallowing and mobility after reconstruction and, therefore, the greater the reconstructive challenge.

Although it is relatively easy to cover a hole with a flap, restoring the volume lost by resection, it is increasingly complex to achieve all the objectives of tongue reconstruction [7]. There are still many challenges associated but with the modern microvascular reconstruction, patients can undergo simultaneous tumor resection and immediate reconstruction with optimal functional and cosmetic outcomes obtained. The appropriate selection of reconstructive techniques should facilitate the healing of both donor and recipient regions, with maximization of patients' capacity for rehabilitation [8]. From a reconstructive standpoint, hemiglossectomies are most ideally managed by free flaps [4].

Case Presentation

A woman in his mid-50s presented with an ulcer on the right side of her tongue associated with sore throat. She had been previously treated multiple times with antibiotics and symptomatic treatment with no response. The lesion progressively grew until it became exophytic. An incisional biopsy showed a well-differentiated squamous cell carcinoma, invasive, ulcerated, p16 positive, with lymphovascular permeation and muscle infiltration so she was referred to a surgical oncologist. There was history of oral sex habits and poor dental hygiene. At physical examination there was a 2.5 x 2 cm neoformation on the right lateral side of the tongue associated with pain, which was mild, intermittent, and localized, the base of

the tongue and floor of the mouth were apparently free (**Figure 1**). There was no restriction of tongue or jaw movements. Local extraoral examination was unremarkable.

Investigations

Through Magnetic Resonance Imaging multiplanar T1-weighted sequences were performed in simple and contrasted phase, T2, FLAIR, SWI and diffusion, finding an irregular lesion of 26 x 31 x 15 mm in the rostrocaudal, dorsoventral and transverse directions, respectively, with poorly defined borders in the right lateral region of the tongue, which behaves isointense on T1, hyperintense on T2 and FLAIR in relation to adjacent muscles; moderately enhances heterogeneously after contrast medium application, diffusion-restricted with medium values of cellularity in the Apparent Diffusion Coefficient (ADC) sequence (intermediate cellularity), does not exceed the midline of the oral cavity, extends towards the ipsilateral retromolar triangle, with incipient ventral involvement of the mylohyoid muscle, it respects the pharyngeal, parapharyngeal, parotid, masticatory mucosal space. Lymph nodes were identified in the submental region, ipsilateral submandibular, superior jugular, and middle bilateral, smaller than 1 cm, which enhance after application of contrast (**Figure 2**). On routine investigation, the patient's complete blood picture and chemistries were unremarkable. Seric levels of IgG antibodies to Human papillomavirus (HPV) in 88.4 IU/ml and IgG antibodies to Epstein-Barr virus (EBV) >750 IU/ml were found.

Treatment

The surgical oncology team decided to perform a right hemiglossectomy plus radical neck dissection. Given the anatomical and functional needs of the area, a microvascular reconstruction with a Radial Forearm Free Flap (RFFF) was chosen (**Figure 3**). During the procedure, the symphysis of the mandible was exposed and a saw for small fragment was used to perform the osteotomy. With right mandibular "swing" approach the lingual artery and vein were identified. The right hemiglossectomy was performed including part of the floor of the mouth, extracting a 2.4 x 1.9 cm tumor involving jugal edge and the specimen was sent for an intraoperative pathologic consultation which revealed an squamous cell carcinoma, invasive, ulcerated, well differentiated and keratinizing, with free margins of 1.4 cm in the posterior edge, 2.1 cm in the medial edge and 0.3 cm in the lateral edge, therefore the lateral margin was widened and the radical neck dissection on the right side was performed.

For the RFFF, the left arm was placed abducting the shoulder at ninety degrees to the patient, an Allen's test showed continuity of the palmar arch, the size of the flap was marked estimating the defect size in 9 x 5 cm, the distal part of the flap was raised first deep to the antebrachial fascial, elevating the fascia with the flap, the Radial Artery (RA) and venae commitans and the cephalic vein were ligated and divided distally, avoiding injury to the dorsal branch of the radial nerve. The flap was sutured to the lingual remnant with monocryl 3-0 creating the neotongue and the vascular pedicle was tunneled and traversed through the floor of the mouth, and an end-to-end RA-facial artery and cephalic vein-facial vein anastomosis was performed with nylon 10-0 (**Figure 4**). Closure was performed with 4-hole titanium plates reducing stress distribution with tension fixation and traction fixation. The defect left by the flap was covered with a partial thickness skin graft harvested from the anterior side of the left thigh fixed with a tie-over dressing technique. It was also decided to perform a tracheostomy plus gastrostomy.

Outcome and follow-up

Final pathology report confirmed epidermoid carcinoma (**Figure 5**) identifying 26 lymph nodes without evidence of metastasis and free-tumor margins, so no adjuvant therapy was needed. On outpatient follow-up two weeks post discharge, the patient had mild pain and profuse salivation, was able to use the left hand as tolerated, the flap was in good condition, wounds in the mouth well addressed, donor area with integrated graft with only a small segment with tendon exposure. One month later G-tube and tracheostomy tube were removed, donor area was already closed, and the patient was sent to speech rehabilitation. One year after the operation, the patient shows a very good result, has intelligible speech when reading a 200-word essay, has flexibility of the tongue, swallowing, and normal diet, and she reports being very satisfied with her appearance (**Figure 6**).

Figure 1: A 2.5 x 2 cm mass on the right lateral side of the tongue.

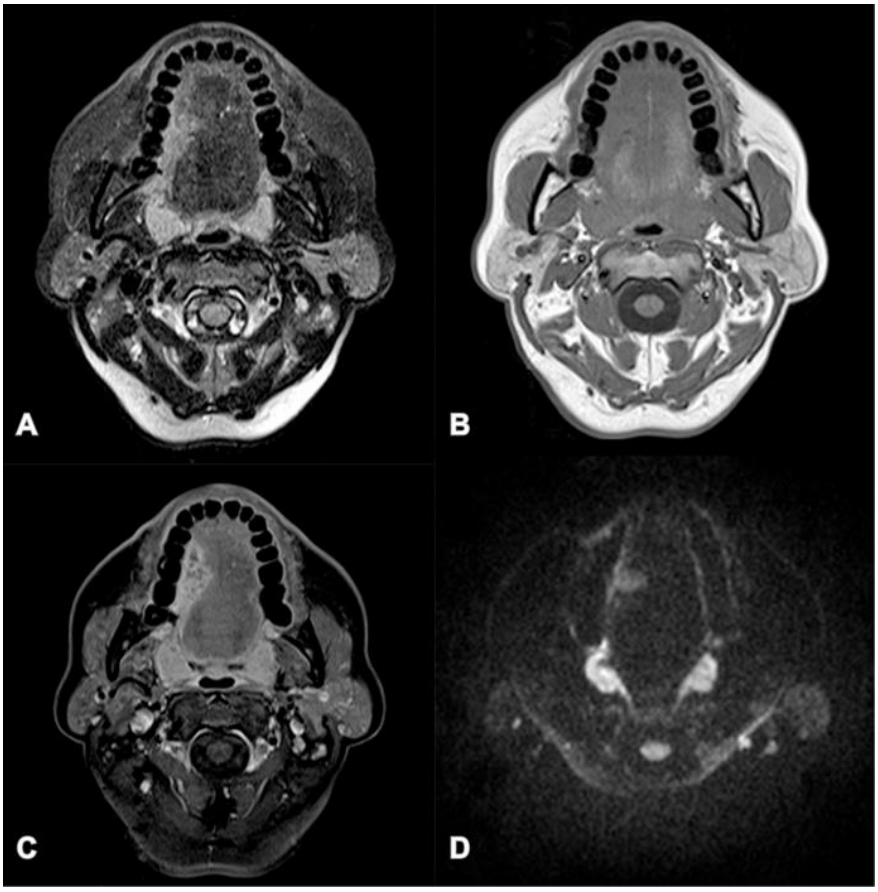

Figure 2: Squamous cell carcinoma of the right lateral aspect of the tongue. Axial T1-weighted MR image demonstrates a low signal intensity tumor (A). On axial FLAIR MR image shows high signal intensity tumor that doesn't cross the midline and extends towards the ipsilateral retromolar triangle (B). Axial gadolinium enhanced T1-weighted fat-suppressed image demonstrates moderately enhancement (C). Diffusion-weighted images shows high signal intensity with low rates of ADC (not showing), which likely represent an intermediate cellularity tumor (D).

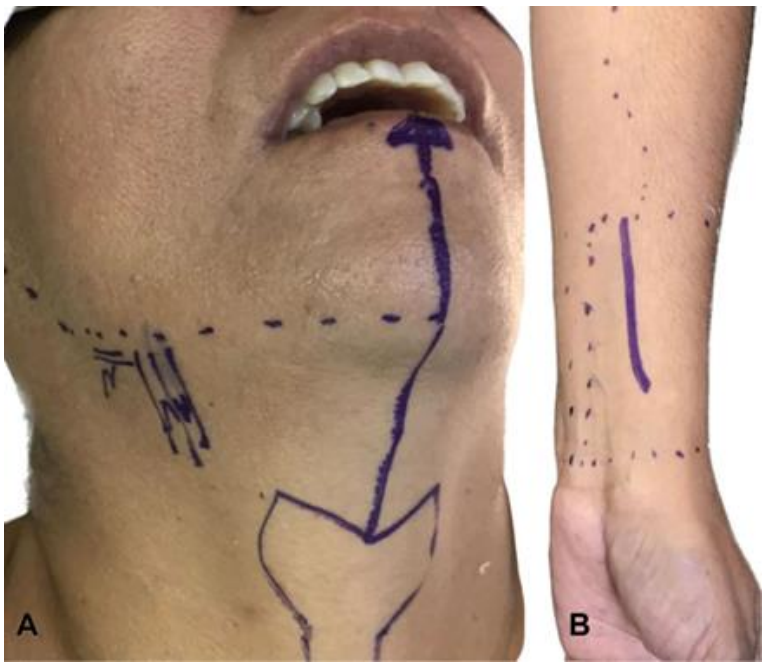

Figure 3: Preoperative markings for right hemiglossectomy plus radical neck dissection (A) and radial free forearm flap harvesting (B) identifying the vascular pedicles through handheld doppler.

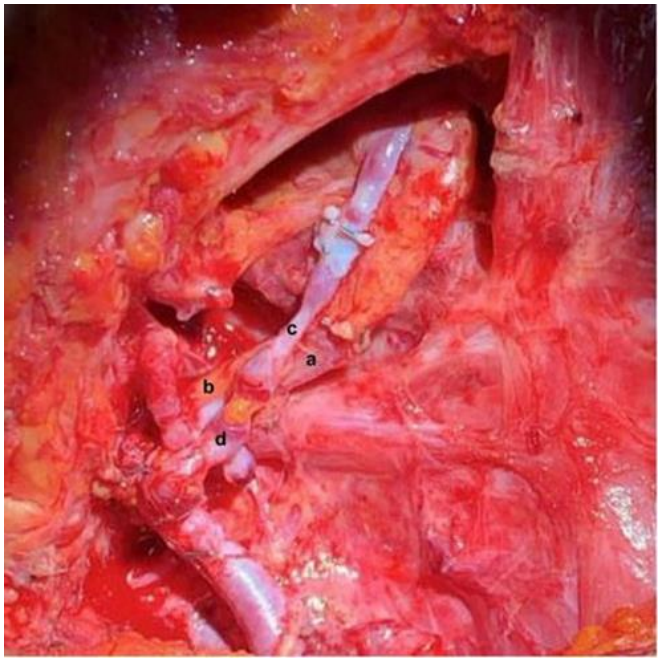

Figure 4: Microvascular end-to-end radial artery (a) to facial artery (b) and cephalic vein (c) to facial vein (d) anastomosis.

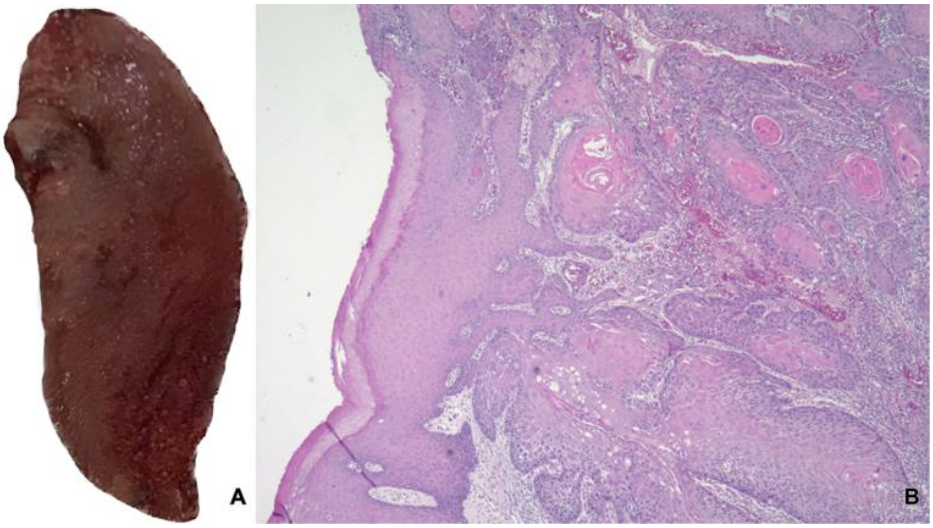

Figure 5: Product of right hemiglossectomy of 7.6 x 3.3 x 2.2 cm with a 2.4 x 1.9 cm tumor involving jugal edge (A) and photomicrograph 10x showing a squamous cell carcinoma, dysplastic stratified squamous epithelium is seen extending through the basement membrane and into the underlying lamina propria in the form of nests, and keratin pearls of round, eosinophilic, and concentric layers of keratin can be seen (B).

Figure 6: Reconstructed hemiglossectomy defect one month after surgery (A) and one year after surgery (B).

Discussion

It is currently recognized that immediate reconstruction at the time of tumor resection optimizes functional results. As a result, oncological surgery with immediate reconstruction has the goal of restoring the shape and function of the resected parts beyond closing resection defects [9]. The tongue is one of the most challenging structures to properly reconstruct because glossectomy causes significant functional deficits due to the intricate tongue anatomy within a relatively small space [10-11]. Studies have shown that the effectiveness of current reconstructive efforts to restore tongue function directly affects patients' Quality of Life (QoL) and their ability to return to normal activities and interaction in society [12]. Therefore, the goals of hemiglossectomy reconstruction are volume reconstitution maintaining the shape and position of the neotongue within the oral cavity, restoration of premaxillary contact for a better articulation of speech sounds, ability to clear oral secretions to maintain oral hygiene and protection against aspiration, to maximize the mobility of the residual tongue optimizing tip/sweeping function avoiding tethering tongue scars that limit tongue mobility, and if possible, to optimize sensation [13].

There is very little guidance in the literature on how to reconstruct tongue defects. However, with the advent of microsurgery, free tissue transfer has opened up avenues for optimizing results based on the providence of adequate tissue bulk with the possibility to model and design the desired form providing versatility of flap inset without tissue tethering. Therefore, free flap reconstruction has become a standard for tongue reconstruction as they were demonstrated to be more reliable and result in superior functional and aesthetic outcomes compared to most prior techniques with success rates now routinely exceed 95 percent or better at most centers [14-16]. The ideal flap should be thin and flexible enough to allow adequate movement and to recreate the shape of a natural tongue as closely as possible. Most reconstructive surgeons would agree that the RFFF best achieves these goals since its first introduction for reconstruction of intraoral defects in 1983. The optimal flap design is debatable since the flap must be prepared in 2D to match a desired 3D defect based on predetermined shapes to improve outcomes [9]. Although neurotized flaps have the theoretical benefit of preventing flap atrophy, no data have definitively demonstrated differences in speech, swallow, or QoL between innervated and noninnervated flaps [13].

The RFFF is favored due to its thinness, flexibility, ease of harvest, and reliability. The thin-skinned paddle with minimal subcutaneous tissue is easy to shape, can be folded and twisted, and forms an ideal maxillary tongue groove being well suited for contouring the glossectomy defect while providing adequate volume for reconstruction without the occurrence of bloating and has little effect on respiration and language after the operation [9]. The RFFF is based on the RA and is rapidly harvested with a long (up to 20 centimeters) pedicle and can be harvested simultaneously with tumor resection, thereby facilitating reconstruction [16]. It has a very reliable vascular pedicle due to its consistent vasculature with an excellent vessel caliber that conforms to the donor vessels in the neck to allow easier microvascular anastomosis [9]. The main disadvantage is that interception of the RFFF involves cutting off the RA, which is the main artery for the forearm therefore it is preferably harvested from the non-dominant arm and a preoperative assessment with Allen's test is imperative to avoid hand ischemia [14]. This procedure can affect the sensation and motor function of the hand, and it can leave an obvious scar on the wrist because partial skin grafts are needed in the donor area and they have a loss rate between 19 and 53%, donor-site flexor tendon exposure occurs in 13 to 33% of cases, and between 16 and 100% of patients' grip or pinch strength is reduced [17].

Patient factors, including age, motivation, and comorbid conditions, are equally important to the success of any reconstruction, especially in the tongue [12]. QoL studies have demonstrated that a highly motivated patient, family, a close physician, and speech therapist follow-up are the best predictors for high QoL scores [13].

Conclusions

Early diagnosis and early treatment of tongue squamous cell carcinoma is the key to patient recovery. Squamous cell carcinoma of the tongue requires reconstruction after surgical resection because it can improve patient quality of life and organ function considerably. Autologous free-flap reconstruction of the tongue allows for an aesthetically pleasing neotongue, a good speech and swallowing outcomes. Motivated patients with good family support who comply with regular follow-up perform better and report better quality of life overall.

Ethics approval and consent to participate

This work was performed according to the principles expressed in the Declaration of Helsinki. Written informed consent was obtained from the patient.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors' contributions

All authors made substantial contributions to the conception or design of the work and reached agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Alfonso Sánchez-Terán: acquisition, analysis, and interpretation of data for the work; Drafting the work and revising it critically for important intellectual content; Final approval of the version to be published. Anyely Nataly Fuertes-Muñoz: analysis and interpretation of data for the work; Revising it critically for important intellectual content; Final approval of the version to be published. Martha Elena Gutiérrez-Brambila: analysis of data for the work; Revising it critically for important intellectual content; Final approval of the version to be published. Juan Carlos Luna-García: acquisition, analysis, and interpretation of data for the work; Drafting the work and revising it critically for important intellectual content; Final approval of the version to be published. Luis Anibal Cervantes-Ruíz: acquisition, analysis, and interpretation of data for the work; Drafting the work and revising it critically for important intellectual content; Final approval of the version to be published. Luis Abraham Zúñiga-Vázquez: analysis of data for the work; Revising it critically for important intellectual content; Final approval of the version to be published. Gerardo Chávez-Pérez: analysis of data for the work; Revising it critically for important intellectual content; Final approval of the version to be published.

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