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Research

Early Rehabilitation in Total Glossectomy with Laryngeal Preservation

Nermin Başerer[1*] and Gökhan Altın[2]

[1]Professor Emeritus, Department of ENT, Medical Faculty of Istanbul University, Istanbul, Turkey.

[2]Medipol Mega University Hospital, Department of ENT-HN Surgery, Istanbul, Turkey.

Abstract

A brief review will be made about three patients who underwent total glossectomy without total laryngectomy. Total glossectomy was performed with bilateral neck dissection and immediate reconstruction of neo-tongue with pedicle pectoralis major myocutaneous bulky flap and laryngeal suspension. Only the adjuvant treatment of the patients was different. We investigated the factors that influence early and late rehabilitation in these cases. The first patientstagedT3pN2bM0 had undergone surgery and follow-up radiotherapy 14 years ago. The tracheostomy cannula was removed one month after radiotherapy, but the gastrostomy feeding tube could be removed 10 months after the surgery. However, during this time she did not break her education and social life with intelligible speech. The second patient, staged T3pN0M0, operated on February 2017, postoperative radiotherapy was not recommended because preoperative radiotherapy was applied on the neck for Hodgkin's lymphoma andmetastasis was not found in the neck dissection. In this young motivated patient early rehabilitation was achieved, the tracheostomy tube was removed at the third week and the nasogastric tube was removed at the fourth week. He returned to a normal diet and good verbal communication. The third patient, staged T3pN2cM0, operated on March 2017. This patient has received postoperative concomitant chemo-radiotherapy. Diffuse fibrosis caused the pharyngo-esophageal segment stricture and oropharyngeal insufficiency. Despite the early decannulation and acceptable speech, the patient failed to drink a sip of water. Swallowing training and cricopharyngeal myotomy were ineffective for now. Adjuvant postoperative therapy delayed rehabilitation. In the surgery alone early rehabilitation was achieved.

Keywords: Total Glossectomy; Total Glossectomy with Laryngeal Preservation; Radiotherapy Fibrosis; Rehabilitation of Swallowing; Rehabilitation of Speech; Pharyngo- Esophageal Segment Stricture.

Abbreviation: Total laryngectomy (TL), Total glossectomy (TG),Total glossectomy with laryngeal preservation (TGLP), Total glosso-laryngectomy (TGL),Squamous Cell Carcinoma (SCC), Pectoralis major myocutaneous flap (PMMCF), Quality of Life (QOL)

Introduction

According to the conventional teaching, total glossectomy with concurrent laryngectomy (total glosso-laryngectomy TGL) must be performed in order to prevent chronic aspiration during swallowing [1]. Addition of the total laryngectomy (TL) with total glossectomy (TG) is a very morbid and grave procedure in head and neck cancer surgery. Because in this case not only the tongue is lost, but also the production of the voice and oro-nasal respiration are lost with larynx. Moreover, the obligation to use tracheotomy cannula which is very difficult to accept for the patients, will adversely affect the quality of life. For the protection of the larynx and speech, laryngoplasty was firstly proposed and applied [2]. The development of the pedicleand free flaps ensured that surgical resection defect was properly closed. After the 1980s, total glossectomy with larynx preservation was gradually increased by those advocating this surgery [3-5]. On the other hand, TG is controversial with the prejudice of the grave functional morbidity and low cure rate and justification has been queried [6]. At the same time, organ preservation treatments have begun to be implemented instead of surgery. This treatment often failed to obtain the functioning organ with the dependence of tracheostomy and gastrostomy tube. This aggressive treatment with side effect such

***Corresponding Author:** Nermin Başerer, Professor Emeritus, Department of ENT, Medical Faculty of Istanbul University, Istanbul, Turkey, e-mail: nerminbaserer@hotmail.com

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as fibrosis, xerostomia, edema, radionecrosis, impaired a successful cure [7,8]. Currently, primary surgery followed by adjuvant radiotherapy with or without chemotherapy is the main treatment option in advanced stage of tongue carcinoma. In the surgery, the resection of the entire tongue and bilateral elective or curative neck dissection are oncologically imperative in order to obtain negative clear margins and control of the regional metastases.

Both appropriate oncologic and reconstructive treatment can offer the chance of survival and good quality of life for the selected patients [9,10]. For the advanced tongue carcinoma with intact larynx and mandible, larynx should be preserved in order to reduce the morbidity. Repair of large oral defect after total glossectomy with immediate neo-tongue reconstruction takes a key role in the surgery [11]. The goals of the reconstruction, first of all, are to obtain a watertight closure, separation of oral cavity from cervical region, and avoid salivary fistula. At the same time, the oropharyngeal swallowing reflex is regained owing to the contact of the reconstructed voluminous neo-tongue with lowering the soft palate during swallowing and speech.

The primary function of the tongue is mastication and swallowing, at the same time the second function is being a major articulator and resonator in speech. Therefore, TG impair the function of mastication, swallowing and speaking. In the surgery of TG with reconstructed voluminous neo-tongue if the larynx, mandible, teeth, lips, hard and soft palate are intact, their existence serves as a compensator in the ability of rehabilitation in swallowing and speaking.

Material

The material of this article constitutes three cases of total glossectomy with larynx preservation. The only differences were in the postoperative treatment of the patients who underwent TGLP as the same surgical treatment. In this way we found the occasion to investigate retrospectively and prospectively the factors that affect the early rehabilitation in these cases. Similarly, among these three patients, we had a chance to compare the early and late functional outcomes, therefore, the investigation of the effects influencing the rehabilitation.

Case 1

The 31-year-old woman staged T3pN2bM0 mobile tongue and tongue base squamous cell carcinoma (SCC) was operated on June 2003. Total glossectomy with larynx preservation (TGLP), bilateral modified radical neck dissection, hyoid and larynx suspension and immediate neo-tongue reconstruction with bilateral pectoralis major myofacial flap was performed instead of pectoralis major myocutaneous flap (PMMC) to intend the breast preservation of the young woman. Tracheostomy cannula and nasogastric tube insertion was applied. At the beginning of the postoperative radiotherapy, gastrostomy feeding tube was inserted. Early decannulation was achieved one month after radiotherapy. Swallowing without aspiration was retarded; gastrostomy tube could be removed after 10 months. During this time, she did not break her PhD studies on the History of Art owing to the good intelligibility of speech. Flap atrophy and flattening of the floor of the mouth was observed (Figure 1).

Figure 1: The atrophied neo-tongue flap with flattened floor of the mouth.

In 2009, rectus abdominus free flap reconstruction was performed for the reconstruction of the second neo-tongue. However, the second neo-tongue also became atrophied. She started to use a tongue prosthesis so that her speech could be better understood in the conversation. However, only moderate increase of intelligibility was achieved (Figure 2).

Figure 2: The oral tongue prosthesis after flap atrophy.

She can eat all kind food, preferably semi-solid. She will soon be a professor of Art History in her academic life with good quality of life (QOL).

Case 2

The 29-year-old man staged T3pN0M0 tongue and tongue base SCC was operated on February 2017 (Figure 3).

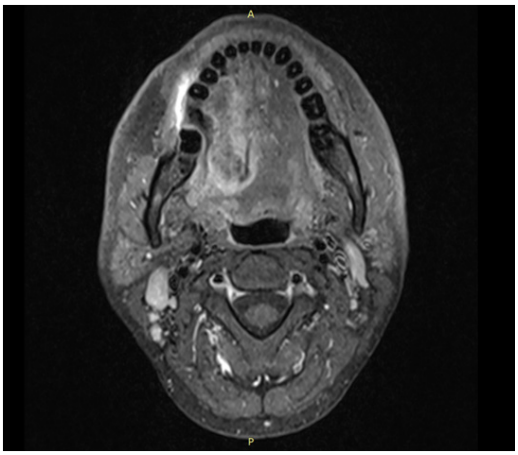

Figure 3: Axial section of the left tongue and tongue base tumor (Case 2).

TGLP and neo-tongue reconstruction with PMMC flap and hyoid-larynx suspension were performed. Tracheostomy cannula and nasogastric tube were applied. For this patient, radiotherapy was not recommended because he had undergone preoperative radiotherapy on the neck for Hodgkin's lymphoma when he was 12 years old. Furthermore, metastasis was not found in the pathological examination of the neck dissection specimens. In this young and well-motivated patient, very early rehabilitation was achieved (Figure 4).

Figure 4: Early speech training (at the ninth day).

The tracheostomy cannula was removed 3 weeks after and the nasogastric tube was removed 4 weeks after the surgery respectively (Figures 5-6).

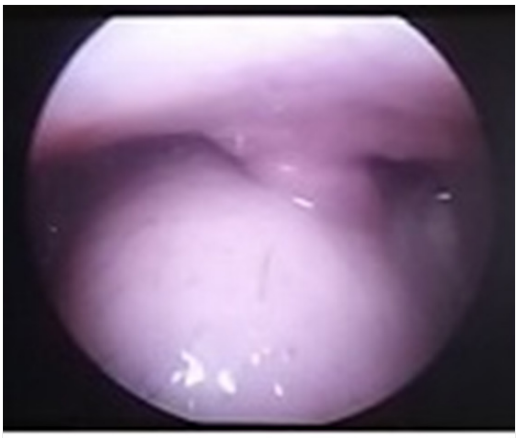

Figure 5: Neo-tongue contact with soft palate in the speech and swallowing.

Figure 6: Reconstructed neo-tongue one month after TGLP.

He returned to a full oral diet and speaking with good intelligibility. He stated that he had no change in taste perception. He regained the good **QOL**, and returned to his work (Figures 7-8).

In this very young patient there was neither tooth hitting nor cigarette, alcohol intake. The HPV test was negative.

Figure 7: Postoperative sagittal section of the left tongue and tongue base tumor (Case 2).

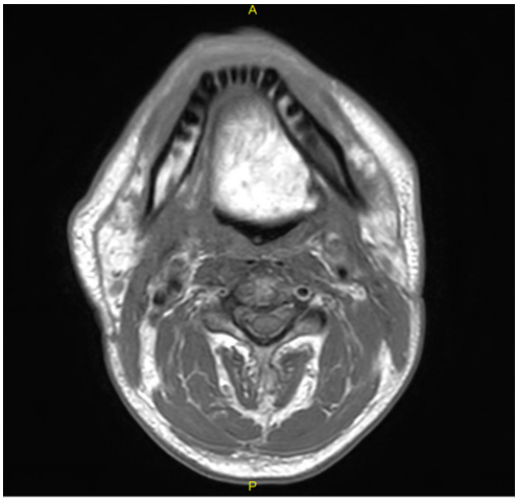

Figure 8: Axial section of the neo-tongue reconstructed with PMMC flap (Case 2).

Case 3

The 55-year-old foreign patient staged T3pN2cM0tongue base SCC. This foreign patient was slightly depressed, had 35 years of smoking history, and the HPV test was negative. He was operated on March 2017 with the same surgical procedure (TGLP bilateral modified radical neck dissection, neo-tongue reconstruction with PMMC and larynx hyoid bone suspension). This patient received postoperative concomitant chemo-radiotherapy due to bilateral multiple neck metastasis and extra capsular nodal invasion. Decannulation was performed three weeks after the end of the chemo-radiotherapy. He could start verbal communication with his family despite the problem of swallowing. Widespread soft tissue fibrosis, pharyngo-esophageal segment stricture and oropharyngeal insufficiency prevented him even to drink a sip of water. He failed in swallowing in spite of the effort of swallowing training and the effects of crico-pharyngeal myotomy were insufficient, the patient began to have very limited fluid intake. Nutrition is still provided by the gastrostomy tube five months after chemo-radiotherapy.

Figure 9 : Post chemo-radiotherapeutic view in the sagittal section (Case 3) (reconstructed neo-tongue and narrowing on the hypopharynx).

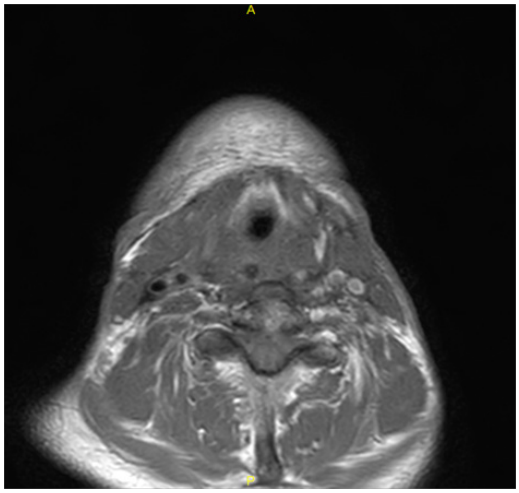

Figure 10: Post chemo-radiotherapeutic view in the axial section of pharyngo-esophageal segment strictureand edema (Case 3).

Method

Employed technique for the entire tongue resection is suprahyoid and trans-oral approach as a pull-through procedure. During the pull through resection, all of the suprahyoid muscles were cut and removed but divided non glossal muscles such as geniohyoid and anterior belly of digastric muscles were protected and stitched on themselves. Therefore, these muscles were shortened; consequently they pulled the hyoid and larynx toward antero-superior so that the larynx suspension was maintained. In the reconstruction of the neo-tongue, the flap was firmly sutured to the mucoperioste of the mandible; in addition the flap muscle was fixed to the anterior mandibular arch bone with non-absorptive two suture in each side for the prevention of the flap prolapsus. The elective or curative modified radical neck dissection was performed in all cases. Because this procedure is mandatory due to the high incidence of clinic or subclinical neck metastases in these aggressive cancers. We prefer PMMC flap because of its adequate bulky volume and easily transferring with its longue and viable pedicle. Besides, the implementation by the same team, the time gain and the minimum morbidity of the donor side were the other advantages of this flap. The reconstructed voluminous neo-tongue touches the lowered soft palate during swallowing. (Figure 4-5). In this way oropharyngeal phase of the swallowing reflex is triggered and the reflex is regained. The patients were very worried about not being able to speak and carry the cannula continuously. It is our early and encouraging rehabilitation method to announce the patient that he / she can speak with closing the cannula with his /her finger) (Figure 3).

Results

In our patients with TG, the larynx, mandible, teeth, lips, hard and soft palates were intact. There was no comorbid disease. The first two patients were young, well-motivated and supported. None of these three patients had a post-operative fistula or aspiration pneumonia. The patients were hospitalized for only two weeks due to the problem free postoperative period. The patients' speech trials were started very early for the support of moral from the third day. All three patients started talking one month after the end of the treatment in an understandable manner. Early tracheostomy decannulation has been an important social psychological support for the patients. The first patient did not disrupt her education despite ten months of gastrostomy tube application. The second young, well-motivated patient did not need postoperative radiotherapy. He began to speak clearly and eat naturally in the first month. In the first patient, the reconstructed tongue with sufficient volume at the start was atrophied over time. Consequently, increased oral cavity caused decreased resonance and impaired speech quality. Six years after the first intervention, the rectus abdominus bulky free musculocutanous flap was applied for the second time. Again, muscular atrophy was developed and the use of tongue prosthesis was recommended (Figure1-2)for reducing the volume of the oral cavity, and providing the contact with the palate in speech and swallowing. Yet the patient reported that the corrective effect of speech prosthesis was moderate. Nevertheless, she teaches as an art historian. There was no adverse change in the swallowing function despite the flattening of the floor of the mouth. It seems that, when the muscular atrophy develops slowly over a long time, the oropharyngeal phase of the swallowing reflex may be intact, and the patient can swallow any kind of crushed food without aspiration.

Our third foreign patient was in a more advanced stage than the first two patients, and was not motivated. Postoperative chemoradiotherapy caused widespread soft tissue fibrosis. As a result, oropharyngeal insufficiency and pharyngo-esophageal segment stricture developed. Nevertheless, decannulation and understandable speech were provided three weeks after the end of the therapy. Swallowing training and crico pharyngeal myotomy were not enabled. The patient was able to drink very little water and continues to be fed with gastrostomy tube at the fifth month. In this patient, the larynx function was non-altered, but the misswallowing and dysphagiawas the result of the large fibrosis of the oropharyngeal complex and stricture of crico-esophageal segment caused by chemo-radiotherapy.

Discussion

Nowadays the treatment of the cancer of the tongue base is controversial because there is a challenge among head neck surgeons, radiation and medical oncologists. At the same time there is no consensus on surgical indications and reconstructive technique**.**

The previous concept that advocates the use of TGL to prevent aspiration has now lost its validity of the routine application of all patients owing to the refinement in surgical and reconstructive techniques. Today TGLP has been advocated for feasibility even in salvage surgery [12]. Total glossectomy with or without laryngectomy followed by radiotherapy is a principal treatment option for advanced T3-T4 stage mobile tongue and tongue base carcinoma. It is almost impossible to treat successfully in advanced stage tongue carcinoma with only definitive radiotherapy [4,12]. The primary surgical treatment in such cases should be total glossectomy with or without laryngectomy and immediate reconstruction using musculocutaneous flaps [4]. We believe that, in the patients undergoing TGLP, if the mandible, teeth, lips, hard and soft palate are intact, the voluminous neo-tongue reconstruction with bulky flap and laryngeal suspension play a key role in the early rehabilitation, especially in young well-motivated patients. Consequently, quite a good QOL, and return to working life can be maintained. The same opinion has been reported in the large case series [13].

The optimal reconstruction of the TG defect is controversial. Various pedicle and free flaps are suggested and applied [11]. Tongue moves in all directions with its intrinsic and extrinsic muscles. A technique that is capable of restoring all the functions of the tongue is not yet available today. In the human body the tongue is an exceptional organ with its complex mobility and its very important functions. The goal of the neo-tongue reconstruction is to replace the resected tongue with inert voluminous

flap. The neo-tongue restores the oropharyngeal phase of the swallowing reflex. The size of the oral cavity varies only slightly with voluminous neo-tongue, consequently speech impairment is decreased with the protection of the sound resonance

We prefer PMMC flap because of its adequate bulky volume and easily transferring with its long and viable pedicle. Besides the implementation by the same team, the time gain and minimum morbidity of the donor side were the other advantages of this versatile flap. Following the reconstructed voluminous neo-tongue, the lowered soft palate during swallowing touches the tongue, so that the oropharyngeal phase of the swallowing reflex is triggered and the reflex is regained. However, because there is no motor innervation and mobility, the pedicle and free muscular flaps become compulsory atrophy over time. It is inevitable that atrophy occur even if the flap is innervated by the motor nerve because there is not enough muscle movement. Reduced neo-tongue volume after long term follow up TG changes functional outcomes [14,15]. Nevertheless, in the first patient there was no swallowing problem despite the decreased intelligibility of speech. It would seem that the regained oropharyngeal swallowing reflex is preserved because atrophy develops slowly. In the case of the flap atrophy, the application of tongue prosthesis was recommended but the increase of the intelligibility of speech was not very satisfactory.

The tongue is a major articulator in verbal communication. Besides this function also involves teeth, lips, hard and soft palate, larynx, and oropharyngeal complex. For this reason, the impairment in articulation is compensated moderately with the presence of these structures. Swallowing reflex activity continues without aspiration in spite of the important flap atrophy.

The observation of very early rehabilitation on the first month in a young motivated patient who did not receive adjuvant radiotherapy showed us that the TG alone is the leastmorbid treatment option. But the advanced stage SSC of the tongue and tongue base do not cure with a single treatment due to the aggressive nature of the tumor. Adjuvant radiotherapy was routinely performed in all our applications. Chemotherapy in the advanced stage of the neck metastases and extracapsular spread and in the presence of histopathological poor prognostic data are recommended currently in the form of the concurrent chemo-radiotherapy. We found the possibility of comparison between surgery alone and postoperative adjuvant radiotherapy and concurrent chemo-radiotherapy owing to our second case of TGLP which is the only and exceptional case in our practice. In the case there was no clinically and pathologically confirmed neck metastasis. Moreover, the neck radiotherapy was applied at 12 years of age due to Hodgkin's lymphoma. In the appropriate indications, this reasonable surgery should not be avoided in selected cases. All three patients underwent TGLP, bilateral neck dissection and neo-tongue reconstruction with pedicle PMMC bulky flap, at the same time suspension of intact larynx with suprahyoid muscles. Therefore, the integrity of the larynx and neo-tongue base was restored, and in the swallowing, antero-superior mobility of the larynx was regained. Widespread fibrosis due the side effect of radiotherapy and chemotherapy prevented laryngeal movement and oro-hypopharyngeal muscles' mobility in the swallowing. It also causes a decrease in the taste. We observed this condition and associated delayed rehabilitation in the first patient undergone postoperative radiotherapy in which oral feeding took place in the tenth month. Whereas in the third patient who undergone chemo-radiotherapy fibrosis and pharyngo-esophageal segment stricture even prevented him to swallow his own saliva. Lin., *et al.* [13] stated that in patients with TG, feeding tube dependence was not associated with laryngeal preservation or the reconstructive technique, including flap innervation and type of flap used. Despite all the hesitations today, TGLP supporters have increased. With meticulous reconstructive technique and appropriate patient selection, TGLP can be performed a primary or even salvage procedure with acceptable functional outcomes [9,10,12-15]. The side effects of radiation or chemo-radiation in the primer and adjuvant therapy are the factors for the functional outcomes in the rehabilitation [7,8]. In the applied same surgical procedure without adjuvant therapy, the early and encouraging rehabilitation was observed in the first month. Whereas in the other two patients, postoperative radiotherapy especially chemo-radiotherapy showed adverse effects on the rehabilitation and prolonged it.

Conclusion

Since the number of cases is small, no doubt we cannot have definitive conclusion about rehabilitation of the patients undergone TGLP. However, the comparison of the rehabilitation outcomes of the patients with different adjuvant therapy gave us some experience when we applied the same surgical procedure**.**

In the light of our experience of oral cavity and oropharyngeal cancer surgery, we believe that the selected patients should be given the chance of regained ability of acceptable swallowing and speech, then reintegration in social and working life. TGLP surgery in the patients cannot be considered a devastating procedure when applied in selected cases.

Properties of the selected case for TGLP and the promising early rehabilitation

Good motivated and good supported especially young patients. They are more capable of adapting to overcoming the difficulties of rehabilitation. Spontaneous rehabilitation occurred after the primary surgery alone in the first month. Larynx, mandible, lips, teeth, soft and hard palate, oropharynx should be intact.

Properties of the non-selected case for TGLP, and causes of late rehabilitation

Total glossectomy with laryngeal preservation should not be performed in the patients with advanced chronological and physiologic age and comorbid disease. TGLP is not suitable in salvage surgery after

radiotherapy or chemo-radiotherapy failures. Because the radiotherapy and specially chemo-radiotherapy were the negative factors in the delay of the early rehabilitation.

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