

TONGUE PROsthESIS: PROsthETIC REHABILITATION OF GLOSSECTOMY PATIENTS- A LITERATURE REVIEW

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Abstract:

Glossectomy whether it is total or partial can result in significant functional impairments in mastication, swallowing, and speech. Voice quality and resonance are compromised because of changes in oral cavity volume, and articulation, management of food and protection of the airway are also jeopardized. Oral rehabilitation through prosthetic management can be very helpful in reducing these problems. Prosthetic rehabilitation can also improve the patient's appearance and psychosocial adjustment. A broad search of published literature was performed using the keywords glossectomy, glossal prosthesis, Palatal augmentation and tongue prosthesis from 1958 to 2018 in Medline, Google scholar and internet. This article aims to review and give basic knowledge of various techniques that can be used in prosthetic rehabilitation of glossectomy patients in different clinical scenarios.

Key words: Glossectomy. Tongue prosthesis. Palatal augmentation prosthesis. Guiding flange. Articulation

Introduction

The tongue is one among the most frequent site for oral cancer. From a psychosocial point, it is one of the most devastating tumor. Mode and aggressiveness of treatment is determined by the size, type and location of the tongue lesions. Even then surgery with or without adjunctive therapy remains the treatment of choice. In most cases they are done in conjunction with radical neck dissections, mandibulectomy, laryngectomy, or other mutilating procedures.¹ Loss of tongue results in varying degrees of impairment of mastication, deglutition, and speech regardless of the extent of the surgical resection.² Functional rehabilitation in these patients can be attempted with a wide variety of techniques and prostheses including skin grafts, local and regional myocutaneous flaps, dental prostheses, and prosthetic tongues.³

The feasibility of a prosthodontic approach to treatment depends on the type and extent of surgery. The primary concern of any rehabilitative effort should be swallowing.¹ Mandibular tongue prosthesis is the treatment of choice in a total glossectomy. A palatal maxillary prosthesis should be considered in situations involving edentulous patient undergone partial glossectomy and an irradiated, resorbed mandibular ridge.⁴ This article reviews different techniques that can be used in prosthetic rehabilitation of glossectomy patients.

Defects with treatment options

The ability to chew and swallow as well as the production of elements for speech articulation which involves tongue positioning is impaired in total and partial glossectomy patients. Articulation is affected because of the inability of the patient to attain the proper cavity shapes and constrictions necessary for precise sound production. Further deterioration of oral function occurs if the mandible is resected.⁵ The rehabilitation depends on the extent of surgery. Functional rehabilitation can be attempted with a wide array of techniques and prostheses including skin grafts, local and regional myocutaneous flaps, dental prostheses, and prosthetic tongues.³ Before treatment, the clinician should evaluate the mobility and sensory status of remaining structures. These findings should be correlated with swallowing studies, patient expectations, and motivation to determine realistic treatment goals.

The first objective of a prosthetic approach to treatment was to determine a prosthesis design that would increase the speaker's potential for constricting and occluding, that is, shaping of the vocal tract, thereby achieving a closer approximation to normal resonance characteristics.⁶

Prosthesis might facilitate speech in the following ways:

- (a) Allow the patient's vocal tract to assume more appropriate volumetric dimensions.
- (b) Enable greater productive and perceptual differentiation for both front-back and high-low vowel distinctions.
- (c) Enable a posterior placement between prosthesis and hard palate to accommodate consonants /k/, /g/ and /rj/.
- (d) Allow greater refinement and differentiation in apical productions.

In addition to these features, a channel that is located laterally in the prosthesis might enable the patient to direct liquids and pureed foods between the prosthesis and the lower alveolar process, and into the oesophagus.⁷

There are various clinical scenarios which are treated with different types of tongue prosthesis.

1. Completely edentulous with total glossectomy.

Treatment: Mandibular denture extending over the floor of the mouth with a mushroom shaped button attached to it on which silicon tongue can be placed.

In this Impressions are made with irreversible hydrocolloid material using a maxillary tray for mandibular arch to record the floor of the mouth. The floor of the mouth becomes concave after a total glossectomy. The mandibular base extends over the floor of the mouth. A "mushroom like" button is constructed on the mandibular prosthesis so that a silicone tongue can be snapped over it.⁵ It can also be attached to the first part by a flexible "collar button" type attachment.⁸ Magnet can also be used to attach silicone tongue component to the acrylic resin base instead of the mushroom like projection.⁴

Two prosthetic tongues can be made, one for speech and one for swallowing. The tongue made for speech is somewhat flat, with a slightly wide anterior elevation to aid in articulation of linguoalveolar sounds `t` and `d` and to aid in shaping the oral cavity for improved vowel production. The tongue for swallowing is made with a trough in the posterior aspect to guide the food bolus into the oropharynx.⁹

One of the objectives for the prosthetic tongue is to increase the speaker's potential for shaping the voice tract to achieve closer to normal resonance. The dome-shaped tongue fills the palatal vault, anterior-to-posterior and laterally, much as the

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normal tongue when the mandible and teeth are closed.³ By varying the vertical distance between the palate and the prosthetic tongue surface, the resonance characteristics of speech can be changed. Vowels, such as /a/, /e/, and /u/, could not be distinguished without the speech tongue. Lingua-dental consonants (/th/) were substituted with the lingua-alveolar consonants (/d/ and /t/). The lingua-alveolar and lingua-velar (/g/ and /k/) consonants are produced by anterior-to-posterior positional changes of the mandible in the horizontal plane.⁶

2. Completely edentulous with total glossectomy and hemimandibulectomy.

Treatment: 1) Mandible is reconstructed with bone graft and implants are placed. After that implant retained overdenture is made with tongue prosthesis.¹⁰

2) Mandibular complete denture obturating the defect and maxillary complete denture with a guiding flange.⁹

Loss of continuity of the mandible affects the balance of the lower face. It leads to deviation of the residual segment toward the resected side.

A guiding flange is made to limit the deviation of mandible towards the resected side.⁵

In implant retained overdenture, use of dental implants improves the biomechanical properties of the prosthesis and assist in regaining some masticatory function.¹⁰

It was also noted that osseointegrated implants can provide reliable retention for prosthesis in edentulous patients but additional surgeries, higher expense and prior radiation therapy might contraindicate implant treatment.⁴

3) Partially edentulous with partial glossectomy involving anterior part of tongue.

Treatment: Maxillary cast partial denture with

palatal augmentation.

The palatal augmentation prosthesis is used in glossectomy patients to restore impaired speech and swallowing by artificially lowering the palatal vault in order to provide contact between the remaining tongue and the palatal contours.⁹ A Dentulous patient treated with a partial glossectomy and radiation therapy, in the absence of a Mandibular resection, may have difficulty with speech and swallowing. This may be a result of loss of tissue in the region or of fibrosis secondary to radiation therapy. The function of the residual tongue is traced with softened modelling compound. The patient is asked to repeat the linguoalveolar sounds /k/ & /g/ for the posterior palatal tracing and the linguoalveolar sounds /t/ & /d/ for the anterior palatal tracing. The compound gets moulded accordingly and then final tracing is done with functional wax, and the entire traced area is processed in clear acrylic resin.⁵

Modification

If acceptable speech articulation is attained for most elements of speech except the linguoalveolar fricatives `s` and `t`, another modification can be done. A narrow, sharp groove carved in the midline of the palatal prosthesis can, by directing the air stream, improve the production of these sounds.⁵

The application of palatal augmentation prosthesis might not improve the swallowing function sufficiently in some patients for whom a large part of the tongue has been resected and the range of movement of the tongue is markedly restricted. In these cases, both palatal augmentation prosthesis and lingual augmentation prosthesis should be used in patients with dysphagia after malignant tongue tumor resection.¹¹

4. Condition: Dentulous patient with segmental resection of mandible and resection of lateral part of tongue.

Treatment: Mandibular cast partial denture

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obturator the defect with a guiding flange and maxillary cast partial denture with palatal augmentation. A cast metal Mandibular prosthesis can be suggested for a patient lacking the motor skills to bring the mandible into occlusion, when the mandible can be manipulated into an acceptable maxillomandibular relationship. The guidance flange for the mandibular framework was designed to extend on the non defect side. Thereby assisting in controlling mandibular deviation and coordinate masticatory movements for a patient following a segmental mandibulectomy.¹²

Maxillary inclined plane prosthesis with cast chrome cobalt framework can be also given in case of subtotal glossectomy. It was also noted that there was a negative change in speech resonance because of a large prosthetic mass in the oral cavity. But it was concluded that swallowing as well as speech was substantially improved with the use of prosthesis.²

Discussion

Tongue is the major articulator during the production of all phonemes except bilabial, labio-dentals and glottal sounds. Tongue movements alter the shape of the oral cavity and change the resonance characteristics that produce different consonants. The coordination of the muscles and nerve is impaired in glossectomy patients even after reconstruction by flap.⁹

A properly fabricated Mandibular prosthesis or a palatal augmentation prosthesis which is done in a systematic manner with the assistance of a

speech pathologist can achieve the following:

1. Reduction in the size of the oral cavity and thereby improving resonance characteristics
2. Direction of food into the oesophagus with the help of a trough carved into the prosthetic tongue
3. Protection of the underlying fragile tissue
4. Development of a surface for the residual tongue tissue to contact during speech and swallowing
5. Improvement in appearance and psychosocial adjustment.⁵

The functions of speech and deglutition are achievable up to an extent without the tongue. But it can be further enhanced towards normalcy with the help of artificial tongue prosthesis.¹²

Early placement of prosthesis to obturate the large defect created by a complete glossectomy improves the patient's ability to produce intelligible speech and return to a relatively normal diet.¹³

Patients who have undergone partial glossectomy are rehabilitated with palatal augmentation prosthesis whereas those who have undergone total glossectomy are rehabilitated with tongue prosthesis for the Mandibular arch.¹⁴ But when resected region is large and the tongue's range of movement is markedly restricted, in such cases, lingual augmentation prosthesis is required along with palatal augmentation prosthesis in order to enhance the function of the remaining tongue and swallowing. Palatal augmentation prosthesis aids in contact between tongue and palate. But In these



Fig 1

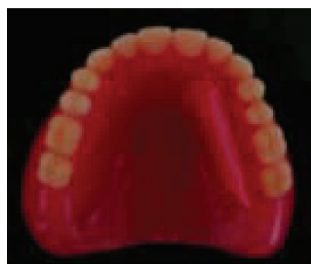


Fig 2



Fig 3

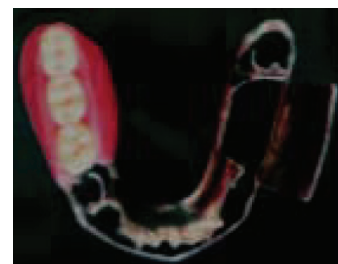


Fig 4

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patients, when palatal augmentation prosthesis alone is used, a functionally significant gap develops between the tongue and the mandible during swallowing.¹¹

The extent of tissue loss determines the degree of articulation impairments in glossectomy patients.¹⁵ Patients who had undergone total glossectomy seemed to develop compensatory patterns of speech, whereas patients who had undergone partial glossectomy require prosthodontic treatment and speech therapy to develop compensatory articulation.¹⁶

The restricted motion of the tongue and lack of lingual-palatal contact are the main causes of speech impairment. Prosthesis can be functionally formed to lower the palatal vault since contact between the tongue and the posterior part of the palate is anatomically impossible.¹⁷

In partial glossectomy cases, palatal vault can be lowered by fabricating a false palate on the maxillary hollow palate denture to enable the tongue to function against it during speech.

During the fabrication of prosthesis, speech is often used as a diagnostic tool in placing the anterior teeth. Similarly, speech can be used to determine the proper placement of a speech portion of the prosthesis.⁴

For the successful function of prosthesis, Space of Donders is essential. Space of Donders can be described as the space between the dorsum of the tongue and the hard palate when the mandible is in rest position following the expiratory cycle of respiration.¹⁸

The tongue and palatal augmentation prosthesis created changes within the vocal tract resulting to changes in the resonating system.¹⁰ A fixed tongue prosthesis can help in certain ways to improve the formation of consonants. Certain consonants like "t," "d," etc., require contact of the tongue with the palate. Although the artificial tongue is fixed, by closure of the jaws it can be made to touch the palate, with marked improvement in the formation

of these consonants. Again, consonants like "c," "s," etc., require a jet of air to be forced in between the tongue and the palate. Here, also, the artificial tongue can be elevated by closing the jaws to form the cleft between the tongue and the palate through which the jet of air can be forced out to form the consonant.¹⁹ Speech therapy is also essential for better functional outcome.¹⁴

Vowel intelligibility was improved in glossectomy patients with the help of a prosthetic tongue. Placing a groove in the lateral aspect of the prosthesis has afforded a practical means of introducing most liquids and pureed foods into the oesophagus.⁷

Interim palatal augmentation prosthesis can be made by using a light-cured resin instead of using techniques that include the use of incremental additions of wax, modelling compound, or tissue-conditioning material to an acrylic resin base.²⁰

While fabricating a tongue prosthesis, the dome-shaped speech tongue, with dimensions of contour and bulk similar to a normal tongue, seemed to be more functional design for both speech and food management. Also it helps to strengthen the Mandibular and oral musculature.⁹

It is easier to achieve more normal Mandibular movements, masticatory performance and improved appearance in dentulous patients compared to edentulous patients.²¹

Consideration should be given to the patient's chief complaint when planning treatment for glossectomy patients. Factors such as the extent of the surgical resection, type of reconstruction, the mobility of the residual oral and paraoral tissues, neuromuscular coordination, mental proficiency, and motivation should be kept in mind while rehabilitating these patients.²²

Summary

The paper reviews technical steps used for the prosthetic rehabilitation of glossectomy patients. The prosthetic tongue might not replace the

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intricately mobile structure of the tongue, which is capable of infinite movements in swallowing and speech.⁷ But the tongue prosthesis serves the dual purposes of speech rehabilitation and maintenance of good nutrition with oral feedings.² Design of the prosthesis varies according to patient needs. The prosthetic design for a total glossectomy patient differs from a partial glossectomy patient. So to improve the articulation, resonance and food intake of a patient, a combined effort of a maxillofacial prosthodontist and a speech pathologist is essential. A well fabricated prosthesis not only improves the function but also improves the appearance and psychosocial well being of the patient thereby helps in enhancing socialization.⁵

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