Original Article

# Analysis of Swallowing After Retromolar or Oropharynx Resection and Reconstruction with Myocutaneous or Microvascular Free Flaps

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## Abstract

**Objective:** Evaluate swallowing in retromolar or oropharyngeal cancer patients submitted to surgical resection and microvascular free flap (MFF) or pedicled myocutaneous flap (MC) reconstruction. **Study:** Retrospective case series. **Patients and methods:** Eighteen previously untreated patients with squamous cell carcinoma of the retromolar area or oropharynx submitted to surgical treatment and reconstruction between January. 2000 and July, 2003, were submitted to videofluoroscopic evaluation. The reconstruction was performed with MFF in 12 cases and MC in 6 cases. Parameters analyzed were: oropharyngeal motility alterations, stasis, laryngeal penetration and/or aspiration and dysphagia severity. **Results:** Oral phase was worse for MC than for MFF patients, with premature bolus leakage (66.7% and 16.7%), increased oral transit time (66.7% and 16.7%), reduced anterior-posterior tongue movement (66.7% and 25%), nasal regurgitation (50% and 0%) and oral stasis (83.3% and 41.6%), respectively. In pharyngeal phase, results were similar in both groups. Main alterations in MFF and MC were, respectively, pharyngeal swallowing delay (83.3% and 100%), nasal regurgitation (58.3% and 83.3%), increased pharyngeal transit time (50% and 83.3%), reduced laryngeal elevation (41.7% and 66.7%), pharyngeal stasis (50% and 16.7%) and laryngeal aspiration (50% and 66.7%). **Conclusion:** Oropharyngeal swallowing after retromolar or oropharyngeal cancer surgery seems to differ depending on the type of reconstruction. Microvascular free flaps seemed to allow a more efficient oropharyngeal deglutition.

**Keywords:** Deglutition. Rehabilitation. Reconstructive Surgical Procedures. Surgical Flap.

## Introduction

The treatment for early stage retromolar or oropharynx squamous carcinoma can be surgery or radiotherapy, with similar survival rates; the rationale to use each option varies among the head and neck surgery services. For advanced stage tumors (CS III and IV), chemoradiotherapy or surgical resection with neck dissection and postoperative radiotherapy are the options but surgery has been contraindicated in most institutions due to the risk of early and late complications. Such patients can face multiple functional sequelae, often severe, in speech, chewing and swallowing functions, leading to alterations in daily, professional and social activities, as well as in nutritional status and cosmesis. In patients submitted

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to surgical resection, immediate reconstruction is essential, aiming to improve functional and aesthetic results as well as long term quality of life.[1,2]

The selection of the type of reconstructions in patients submitted to resection of oropharynx cancer depends mainly on the anatomical characteristics of the surgical defect.1,3 The pectoralis major myocutaneous flap (MC) used to be the most common in repairing large defects, allowing for an acceptable functional rehabilitation for both speech and swallowing. However, it can be bulky and presents as a disadvantage the risk of postoperative complications, such as partial or total necrosis, fistulae, dehiscence, and infection, which can negatively interfere with the swallowing rehabilitation process, increasing the time of enteral (tube) feeding and hospitalization costs which can be twice as high.[3-5]

On the other hand, microvascular free flaps (MFF) present as advantages the wide variety of options and a low rate of postoperative complications, allowing early beginning of speech and swallowing functional rehabilitation process.[3-7] It is also possible to achieve sensibility of the reconstructed area, which facilitates the proprioception of food for swallowing. The significant disadvantage of such reconstruction method is the necessity of a high specialized surgical team to perform it.[3-7]

According to Tsue et al.,[5] the goals of reconstruction after surgical extirpation include maximizing function and cosmesis with the least morbidity. Several authors pointed out that MFF reconstruction presents better postoperative functional results than MC reconstruction, and also reduces postoperative complications rates, duration of hospitalization, length of enteral feeding use and hospital costs.[4,5,7-12]

The objective of this descriptive study was to analyze the swallowing function of patients submitted to resection of oropharyngeal cancer and oropharynx reconstruction with MC or MFF.

## Patients and Methods

This cross sectional retrospective study included patients treated from January, 2000 to July, 2003. It was approved by the Institution Ethics and Research Committees.

The eligibility criteria was previously untreated patients with squamous cell carcinoma of the retromolar area, soft palate and/or tonsil, submitted to surgical resection and MC or MFF reconstruction, who accepted to have a swallowing videofluoroscopy (VF). Clinical and demographic information were obtained from the patient's medical charts.

Although this study was initially designed to evaluate patients with oropharyngeal tumors, similarities in clinical behavior and surgical approaches led to include also patients with retromolar area tumors.

Videofluoroscopic (VF) exams were performed simultaneously by a radiologist and a speech therapist. The equipment used for VF was a X-ray equipment, system 1600E, and the images were recorded on videotapes. The VCR used was a Sharp (VHS HQ 4Heads). Patients were in a standing position and the image previously limited anteriorly by the lips, superiorly by the hard palate, posteriorly by the pharyngeal posterior wall and inferiorly by the airway bifurcation at the level of the 7$^{th}$ cervical vertebra. The presentation of different food types and quantities was performed on the lateral view. Material used was liquid barium mixed with water (1:1 proportion) for the liquid consistency assessment, and liquid barium for the paste-liquid consistency assessment. Patients were instructed to swallow the liquid and the paste-liquid material in the quantities of 5ml and 20ml (5ml in the spoon and 20ml in the glass). The paste bolus was presented three times in the quantity of 5ml in the spoon. In this study, solid food swallowing was not assessed.

The results of the swallowing videofluoroscopic parameters were evaluated and defined according to the agreement of three experienced speech therapists. The items analyzed included the presence or absence of physiological alterations in the different phases of swallowing, the identification of laryngeal penetrations and/or aspirations, and the moment when they occurred (before, during or after swallowing). Penetration and/or aspiration levels and dysphagia severity were classified according to the scales by Rosenbek et al.[13] and O'Neil et al.[14] respectively.

Fisher's exact test was used to compare variables among the patient's groups. Statistical level of significance was set at 5%.

## Results

Eighteen patients were included; 12 submitted to MFF and 6 to MC reconstruction. From the 12 patients submitted to MFF reconstruction, 9 (75%) were male and 3 (25%) female, with ages varying from 24 to 78 years (median: 53 years). From the 6 patients submitted to MC reconstruction all were male, with ages between 46 and 60 years (median: 55.5 years). Patients demographic data, TNM staging, tumor site and treatment characteristics are summarized in Table 1.

Ablative surgery performed on the individuals with MFF reconstruction was a wide resection thought

**Table 1** - Distribution of cases according to demographic, clinical and treatment data

| Variable | Reconstruction Type | | | |
|---|---|---|---|---|
| | Microvascular | | Myocutaneous | |
| | N | % | N | % |
| Gender | | | | |
| Male | 9 | 75.0 | 6 | 100 |
| Female | 3 | 25.0 | 0 | 0 |
| Age | | | | |
| Range | 24-78 | | 46-60 | |
| Median | 53 | | 55 | |
| Mean ± SD | 51.5±15.2 | | 54.3±5.75 | |
| Stage T[15] | | | | |
| T1 + T2 | 2 | 16.7 | 1 | 16.7 |
| T3 + T4 | 5 | 66.7 | 5 | 83.3 |
| Stage N[15] | | | | |
| N0 | 6 | 50.0 | 3 | 50.0 |
| N+ | 5 | 41.7 | 3 | 50.0 |
| Nx | 1 | 8.3 | 0 | 0 |
| Stage M[15] | | | | |
| M0 | 12 | 100 | 6 | 100 |
| Tumor site | | | | |
| Soft palate | 3 | 25.0 | 0 | 0 |
| Retromolar trigone | 1 | 8.3 | 3 | 50.0 |
| Tonsillar region | 8 | 66.7 | 3 | 50.0 |
| Surgery type | | | | |
| Soft palate resection | 2 | 16.7 | 0 | 0 |
| Commando operation* | 1 | 8.3 | 4 | 66.7 |
| Wide resection with mandibulectomy | 9 | 75.0 | 2 | 33.3 |
| Neck dissection | | | | |
| SOH* | 7 | 58.3 | 3 | 50.0 |
| Radical | 2 | 16.7 | 3 | 50.0 |
| Modified radical | 1 | 8.3 | 0 | 0 |
| No | 2 | 16.7 | 0 | 0 |
| Radiotherapy | | | | |
| No | 5 | 36.4 | 2 | 33.3 |
| Preoperative | 0 | 0 | 1 | 16.7 |
| Postoperative | 7 | 63.6 | 3 | 50.0 |
| Radiotherapy dosis | | | | |
| Range | 4500-6040 | | 5040-7040 | |
| Median | 5040 | | 6040 | |
| Mean ±SD | 5100±459.71 | | 6220±846.48 | |

paramedian mandibulotomy in nine cases (75%). Among individuals who underwent MC reconstruction, four (66.7%) had *enbloc* resections and two had wide resection thought paramedian mandibulotomy.

Reconstruction was performed at the same time as primary tumor resection in 11 (91.7%) and in six (100%) of the individuals with MFF and MC reconstructions, respectively. Regarding the group of free flap reconstruction, in six (50%) patients the antebrachial flap and in the other six (50%) the lateral arm free flap was used. In all the individuals submitted to MC reconstruction, the pectoralis major flap was used.

Considering the interval between postoperative radiotherapy and videofluoroscopy evaluation in the MC group, two patients had the exam performed between seven and nine months after radiotherapy, two before six months and two had not received radiotherapy. For the patients in the MFF group, two had the exam between one and two months after radiotherapy, five before starting postoperative radiotherapy and five had not received adjuvant treatment.

At the time of VF, 50% of the patients in the MFF group and 16.7% of the MC were receiving oral feeding only, and all remaining patients in both groups were feeding by nasogastric tube. The characterization of the interval between surgery and VF exam as well as the feeding during VF and the data about rehabilitation are summarized in Table 2.

In the oral preparatory phase alterations with similar percentages between the groups were observed, except in four (66.7%) patients with premature bolus leakage in the group with MC reconstruction, against two (16.7%) in the MFF group. The main alterations observed in the oral and pharyngeal phases of deglutition are showed in Tables 3 and 4.

The evaluation of dysphagia severity level (O'Neil et al.)[14] showed that an alternative way for feeding (levels 1 and 2) was necessary in five subjects (41.7%) of the MFF group and in 3 (50%) of the MC group. Oral feeding was possible but in a modified manner and/or independent of alternative feeding (levels 3, 4 and 5) in five (42.6%) and in three (50%) patients with MFF and MC reconstructions, respectively. Only in the MFF reconstruction group a regular diet or functional deglutition was observed in two (16.7%) patients (Table 5). According to the laryngeal penetration/aspiration scale (Rosenbek et al.),[13] there was penetration in 50% of the patients in both groups. The other 50% of patients remained with silent laryngeal aspiration (Table 5).

The number of resected structures was associated with the dysphagia severity level observed in both groups:

**Table 2** - Characterization of the interval between surgery and videofluoroscopic exam, the feeding pathway during VF, time of nasogastric tube use speech therapy duration and number of speech therapy sessions and the feeding pathway at the time of the dismissal from speech therapy for the microvascular and myocutaneous groups

| Variables | Reconstruction Type | | | | p |
|---|---|---|---|---|---|
| | Microvascular | | Myocutaneous | | |
| | N | % | N | % | |
| Interval between surgery and VF (Days - Mean±SD) | 74±72.68 | | 194±174.3 | | 0.122* |
| Feeding pathway during VF | | | | | |
| Oral | 6 | 50.0 | 1 | 16.7 | 0.316 |
| Nasogastric tube | 6 | 50.0 | 5 | 83.3 | |
| Time of nasogastric tube use (Days - Mean±SD) | 89.18±69.2 | | 419.2±331.7 | | 0.015* |
| Traqueostomy during VF | | | | | |
| No | 10 | 83.3 | 4 | 66.7 | <0.099 |
| Yes | 2 | 16.7 | 2 | 33.3 | |
| Therapy duration (Months - Mean±SD) | 2.09±1.85 | | 6.63±3.57 | | 0.006* |
| Number of speech therapy sessions (Mean±SD) | 8.66±6.48 | | 17±10.39 | | 0.066* |
| Feeding pathway at the end of therapy | | | | | |
| Oral | 8 | 66.7 | 4 | 66.7 | |
| Nasogastric tube | 2 | 16.7 | 1 | 16.7 | NA |
| Oral + NGT | 2 | 16.7 | 1 | 16.7 | |

when surgical resection included more than two adjacent structures the dysphagia severity level was worse (Table 5) in both groups. We considered adjacent structures all anatomic portions outside the primary tumor site.

## Discussion

After upper respiratory and digestive tract tumor resection, reconstructive surgery must be done in most patients to restore cosmesis as well as to rehabilitate swallowing and speech functions.[5,7,16] Several studies have been performed in the attempt to compare different oropharynx reconstruction methods.[4,5,7-9,11,17-20] In most publications, antebrachial free flaps presented

**Table 3** - Oral phase of deglutition based on the videofluoroscopy findings of both groups

| Variables | Reconstruction Type | | | | p |
|---|---|---|---|---|---|
| | Microvascular | | Myocutaneous | | |
| | N | % | N | % | |
| Increased oral transit time | | | | | |
| No | 10 | 83.3 | 2 | 33.3 | 0.107 |
| Yes | 2 | 16.7 | 4 | 66.7 | |
| Tongue contact with the palate | | | | | |
| No | 12 | 100 | 5 | 83.3 | NA |
| Yes | 0 | 0 | 1 | 16.7 | |
| Reduced antero-posterior tongue movement | | | | | |
| No | 9 | 75.0 | 2 | 33.3 | 0.141 |
| Yes | 3 | 25.0 | 4 | 66.7 | |
| Nasal cavity reflux | | | | | |
| No | 12 | 100 | 3 | 50.0 | NA |
| Yes | 0 | 0 | 3 | 50.0 | |
| Oral cavity stasis | | | | | |
| No | 7 | 58.3 | 1 | 16.7 | 0.152 |
| Yes | 5 | 41.7 | 5 | 83.3 | |
| Reconstruction stasis | | | | | |
| No | 8 | 66.7 | 5 | 83.3 | 0.615 |
| Yes | 4 | 33.3 | 1 | 16.8 | |

NA does not apply; p value by Fisher's exact test

superior results when compared to the pectoralis major myocutaneous flap. These results are mainly related to the possibility of proprioception restoration and to the lower rate of postoperative complications.[4,7-9] Regarding pectoralis major myocutaneous flap, some studies showed a high rate of postoperative complications, which contributes to the increased rehabilitation time and higher costs at the end of treatment.[5] When oropharynx resection is extended to other surrounding tissues and postoperative radiotherapy is employed, more severe sequelae in the deglutition process are expected.[9,16-22]

In this study, patients with tumors in the tonsillar region, soft palate and retromolar trigone were included. However, as this is a retrospective study including just patients that were referred to speech pathology care and had swallowing videofluoroscopic images performed, the

**Table 4** - Pharyngeal phase of deglutition of both groups

| Variable | Category | Reconstruction Type | | | | p |
|---|---|---|---|---|---|---|
| | | Microvascular | | Myocutaneus | | |
| | | N | % | N | % | |
| Pharyngeal phase delay | No | 2 | 16.7 | 0 | 0 | NA |
| | Yes | 10 | 83.3 | 6 | 100 | |
| Reduced tongue base contact with phraynx | No | 5 | 41.7 | 1 | 16.7 | 0.600 |
| | Yes | 7 | 58.3 | 5 | 83.3 | |
| Nasal cavity reflux | No | 5 | 41.7 | 1 | 16.7 | 0.600 |
| | Yes | 7 | 58.3 | 5 | 83.3 | |
| Phrayngeal transit time | No | 6 | 50.0 | 1 | 16.7 | 0.316 |
| | Yes | 6 | 50.0 | 5 | 83.3 | |
| Reduced laryngeal elevation | No | 7 | 58.3 | 2 | 33.3 | 0.620 |
| | Yes | 5 | 41.7 | 4 | 66.7 | |
| Tongue base stasis | No | 2 | 16.7 | 0 | 0 | NA |
| | Yes | 10 | 83.3 | 6 | 100 | |
| Vallecula stasis | No | 0 | 0 | 0 | 0 | NA |
| | Yes | 12 | 100 | 6 | 100 | |
| Pyriform sinus stasis | No | 6 | 50.0 | 3 | 50.0 | 0.999 |
| | Yes | 6 | 50.0 | 3 | 50.0 | |
| Nasopharynx stasis | No | 8 | 66.7 | 2 | 33.3 | 0.321 |
| | Yes | 4 | 33.3 | 4 | 66.7 | |
| Superior esophagus sphincter stasis | No | 3 | 25.0 | 1 | 16.7 | 0.999 |
| | Yes | 9 | 75.0 | 5 | 83.3 | |
| Posterior pharyngeal wall stasis | No | 6 | 50.0 | 5 | 83.3 | 0.316 |
| | Yes | 6 | 50.0 | 1 | 16.7 | |
| Arytenoid stasis | No | 8 | 66.7 | 4 | 66.7 | 0.999 |
| | Yes | 4 | 33.3 | 2 | 33.3 | |
| Laryngeal penetration | No | 4 | 33.3 | 0 | 0 | 0.245 |
| | Yes | 8 | 66.7 | 6 | 100 | |
| Laryngeal aspiration | No | 4 | 33.3 | 3 | 50.0 | 0.627 |
| | Yes | 8 | 72.7 | 3 | 50.0 | |
| Mechanical dysphagia | No dysphagia | 3 | 25.0 | 0 | 0 | NA |
| | Pharyngeal | 3 | 25.0 | 0 | 0 | |
| | Oropharyn-geal | 6 | 50.0 | 6 | 100 | |

NA does not apply; p value by Fisher's exact test

interpretation of the findings has to be done with care. In this series, most lesions were diagnosed in advanced stages, and there was a need to perform mandibulotomy and/or mandibulectomy for a satisfactory oncologic resection, which can include adjacent tissues such as the masseter and pterygoyd muscles. Thus, the studied groups were comparable, but there was a higher number of mandibulectomies in the group submitted to MC

**Table 5** - Distribution of dysphagia severity level (DSL),[12] penetration/aspiration scale (PAS),[18] and number of resected adjacent structures correlated with dysphagia severity level

| Variable | | Frenquency | | | |
|---|---|---|---|---|---|
| | Level | MFF | | MC | |
| | | DSL | PAS | DSL | PAS |
| Classification of the dysphagia severity Level of Penetration/aspiration scale | 1 | 2 | 3 | 0 | 0 |
| | 2 | 3 | 1 | 3 | 2 |
| | 3 | 1 | 0 | 0 | 1 |
| | 4 | 1 | 0 | 2 | 0 |
| | 5 | 3 | 2 | 1 | 0 |
| | 6 | 2 | 1 | 0 | 1 |
| | 7 | 0 | 0 | 0 | 1 |
| | 8 | 0 | 5 | 0 | 1 |
| Adjavent structures resected (n°) | | | | | |
| 1 | 1,2 | 0 | | 1 | |
| | 3,4,5 | 1 | | 0 | |
| | 6 | 1 | | 0 | |
| 2 | 1,2 | 4 | | 1 | |
| | 3,4,5 | 1 | | 3 | |
| | 6 | 1 | | 0 | |
| ≥3 | 1,2 | 1 | | 1 | |
| | 3,4,5 | 3 | | 0 | |
| | 6 | 0 | | 0 | |

reconstruction.

In the analysis of dysphagia degree and way of feeding we observed similar results for both groups. However, regarding nasogastric tube feeding use, it was verified that less patients from the MFF group were using it, even though the same dysphagia severity level was observed in them. These data are associated with shorter rehabilitation period for the MFF group (mean of 61.1 days and 8 speech therapy sessions) than for the MC group (mean of 201.7 days and 17 speech therapy sessions), probably due to a lower rate of postoperative complications, as suggested by Tsue et al.[5] These authors and Abemayor and Blackwell[4] agreed that hospital costs are higher for patients with MC reconstructions compared to MFF, mainly due to the high level of postoperative complications. Abemayor & Blackwell[1] stated that speech and swallowing rehabilitation were faster for patients submitted to MFF reconstruction. Ortiz et al.[7] reported that swallowing functional rehabilitation is affected by the extension of the resection.

In both groups, the oral preparatory phase presented few alterations, particularly premature leakage of food, mainly for patients in the MC group (n=4, 66.7%). Tonsil pillars resection associated or not to xerostomia, edema and/or sensibility reduction probably led to the delay or absence of the initial phase of swallowing, justifying such findings.[16,18,19,22,23]

Although there were no significant differences, swallowing alterations of the oral phase were more evident in patients with MC reconstruction, confirming the findings of literature, with reference to the increased oral transit time, reduced anteroposterior tongue movement and nasopharyngeal reflux.[9,19,23] There alterations are attributable to sensibility reduction, velopharynx dysfunction/disorder and reduced tongue strength.[9,19,23] McConnel et al.[9] and Pauloski and Logemann[19] consider that the base of the tongue contact with the pharynx is the key element in producing pharyngeal bolus driving pressure and effective bolus clearance through the pharynx.

The results of the pharyngeal phase analysis showed alterations for both groups, but especially for patients with MC reconstructions. The prevalence of nasopharynx residue in the MC group is justified by the fact that surgery does not promote mobility of the reconstructed area as efficiently as in the MFF group.[6,8,12,17,24] Several studies[6,8,12] mention partial recovery of movement after MFF reconstruction, which does not occur with MC flaps.

Laryngeal penetration and aspiration were more frequent in the MC group, possibly due to velopharyngeal sphincter inefficiency or insufficiency interfering in the adequate pressure generation of swallowing, favoring the presence of endolaryngeal residue, and consequently penetrations and aspirations.

Oropharyngeal dysphagia was diagnosed in 6 (50%) patients in the MFF group and in 6 (100%) in the MC group. Three patients (25%) in the MFF group did not present dysphagia. This result corroborates other series in which there were alterations in the three phases of swallowing (oral preparatory, oral and pharyngeal phases) in patients who underwent the MC reconstructions.[6,9,23]

Using the dysphagia severity scale proposed by O'Neil et al.,[14] 41.7% and 50% of patients in the MFF and MC groups, respectively, needed only non-oral nutrition, which corresponds to levels 1 and 2. The same percentage of patients needed to receive full oral nutrition with modified and/or independent diet (levels 3,4 or 5). Two patients (16.7%) of the MFF group could receive full

per-oral nutrition with normal diet (levels 6 and 7). Many studies[6,8,11,12,24] showed advantages of MFF over MC flaps in reducing swallowing functional sequelae.

The dysphagia severity level was evaluated as bad for the two groups when surgical resection was extended to 2 or 3 adjacent structures. These results suggest that the quantity of resected structures associated with the primary lesion resection has a correlation with the level of dysphagia severity. We observed that in the MFF group no patient with three or more adjacent structures resected presented functional swallowing. When pharynx, tongue base and/or soft palate resection was associated to the primary lesion, dysphagia severity was worse. McConnel et al.[9] reported that when the percentage of tongue base and oral tongue resection increases, the efficiency of deglutition decreases. Kimata et al.[12] reported that patients with soft palate tumors associated with resection of more than two thirds of the superior and posterior oropharyngeal wall are poor candidates for reconstruction due to the difficulties in maintaining good nasal airing and velopharyngeal function. Seikaly et al.[11] suggested that MFF reconstruction could offer the structures necessary to prevent inefficient deglutition in patients submitted to wide resections.

The Penetration-Aspiration Scale[13] evaluation had a similar distribution between the groups, which is also related to the alteration of the adequate pressure generation of swallowing, presence of oropharyngeal and hypopharyngeal residue and to reduced laryngeal elevation. Regarding silent aspiration, post-radiotherapy edema and residues can reduce the sensibility of the endolaryngeal region.[10,16,18,20,21] It was not possible to confirm the effect of radiotherapy in the studied groups due to the small number of cases.

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