

HEAD AND NECK

# Advanced carcinoma of the hypopharynx: functional results after circumferential pharyngolaryngectomy with flap reconstruction

## *Carcinoma avanzato dell'ipofaringe: risultati funzionali dopo faringolaringectomia circolare e ricostruzione con lembo*

F. MURA, G. BERTINO, A. OCCHINI, N. MEVIO, D. SCELSE, M. BENAZZO

Department of Otolaryngology Head Neck Surgery, University of Pavia, IRCCS, Policlinico "S. Matteo" Foundation, Pavia, Italy

### SUMMARY

Surgical treatment of advanced cancers of the hypopharynx inevitably impairs swallowing, respiration and phonation. The purpose of this study was to analyze the functional results after circumferential pharyngolaryngectomy (CPL) and flap reconstruction, in order to offer decisional guidelines for the choice of the most effective reconstructive method. We performed a retrospective analysis on the medical records of patients submitted to reconstructive surgery after CPL from July 1991 to November 2011. 75% of the 94 patients underwent reconstruction with a free flap (group A), while 25% underwent reconstruction with a pedicled flap (group B); 80% of patients in group A and none in group B were discharged with a free diet; 14% of patients in group A and 26% in group B were unable to resume oral feeding and were discharged with NG-tube or PEG. None of the patients acquired a satisfactory oesophageal voice; 17% of patients in group A and 7% in group B underwent voice restoration with tracheo-oesophageal voice-prosthesis. In conclusion, free flaps should be considered the first choice for reconstruction of the hypopharynx after CPL because of the better functional results obtained. Pedicled flaps represent a valid alternative in patients with contraindications to microvascular surgery.

**KEY WORDS:** Hypopharyngeal cancer • Flap reconstruction • Circumferential pharyngolaryngectomy • Functional results

### RIASSUNTO

*Il trattamento chirurgico dei carcinomi ipofaringei in stadio avanzato comporta alterazioni funzionali della deglutizione, della respirazione e della fonazione. Lo scopo di questo studio è stato quello di analizzare i risultati funzionali dopo intervento di faringolaringectomia circolare (FLC) e ricostruzione con lembo al fine di definire nell'ambito dell'algoritmo decisionale chirurgico il miglior metodo ricostruttivo. Abbiamo condotto un'analisi retrospettiva sulle cartelle cliniche dei pazienti sottoposti ad intervento di FLC e ricostruzione con lembo dal Luglio 1991 al Novembre 2011. Il 75% dei 94 pazienti analizzati sono stati ricostruiti con un lembo libero (gruppo A), mentre il 25% sono stati sottoposti a ricostruzione con lembo peduncolato (gruppo B); l'80% dei pazienti del gruppo A e nessuno del gruppo B sono stati dimessi con una dieta libera; il 14% dei pazienti del gruppo A ed il 26% del gruppo B non sono stati in grado di riprendere l'alimentazione per os e sono stati dimessi con SNG o PEG. Nessuno dei pazienti ha acquisito una soddisfacente voce esofagea; il 17% dei pazienti del gruppo A ed il 7% dei pazienti del gruppo B sono stati sottoposti a riabilitazione chirurgica della voce mediante valvola fonatoria tracheo-esofagea. I lembi liberi devono essere considerati come prima scelta per la ricostruzione dell'ipofaringe dopo FLC poiché consentono di ottenere i migliori risultati funzionali. I lembi pedunculati tuttavia rappresentano una valida alternativa nei pazienti con controindicazioni alla chirurgia microvascolare.*

**PAROLE CHIAVE:** Cancro dell'ipofaringe • Ricostruzione con lembi • Faringolaringectomia circolare • Risultati funzionali

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### Introduction

Surgical treatment of advanced cancers of the hypopharynx involves unavoidable impact on deglutitory and respiratory and vocal functions as the anatomical structure is located at the crossing point between the airway and digestive tract. The degree of impairment is directly proportional to the extent of resection. If small defects of the pyriform sinus can be resolved with a primary closure with minimal impact on swallowing, wide defects involv-

ing more than 50% of the hypopharyngeal tissue, with or without sacrifice of part or all of the larynx, there is a definite need for reconstructive procedures to re-establish swallowing, phonation and breathing<sup>1</sup>.

If the use of a flap is required, its choice must be made taking into account the anatomical and functional characteristics of the tissue removed, the characteristics of the recipient and the donor site, the patient's general conditions and the experience of the surgeon<sup>2</sup>.

The purpose of this study was to verify the functional results after circumferential pharyngolaryngectomy and reconstruction with pedicled or free flaps in order to define a surgical decision algorithm that can provide patients with advanced carcinoma of the hypopharynx the best quality of residual life, with the lowest risk of fatal post-operative complications.

## Materials and methods

A retrospective analysis was conducted on medical records of patients submitted to circumferential pharyngolaryngectomy and reconstruction with pedicled or free flaps from July 1991 to November 2011.

We analyzed the following parameters:

- clinical staging of the tumour according to the TNM classification<sup>3</sup>;
- type of surgical reconstruction;
- type of complications, classified in major or minor according to the need to submit patients to revision surgery or not;
- duration of hospital stay;
- days of nasogastric (NG)-tube feeding and type of diet at discharge;
- type of voice-rehabilitation.

The statistical analysis of the differences between the two groups was performed using a 2-tailed Student's test; a p-value < 0.05 was considered significant.

## Results

Ninety-four patients (85 males, 9 females) aged between 45 years and 82 years (median 60.5 years) were eligible for the study. Table I summarizes the clinical stage of the cohort. Twenty-four (26%) patients had a stage III and 70 (74%) a stage IV tumour.

Seventy (75%) of the 94 patients were reconstructed with a free flap (group A), while 24 (25%) underwent reconstruction with a pedicled flap (group B) (Table II). Fifty-eight (83%) patients in group A underwent reconstruction with a jejunum flap, 9 (13%) with a radial forearm flap (RFF) and 3 (4%) with an anterolateral thigh flap (ALT). In the group B, the pectoralis major (PM) was used in 22 of 24 patients (92%); while the remaining 2 cases (8%) were reconstructed with a latissimus dorsi flap (LD).

All patients in group B presented general contraindications to microvascular reconstruction with free flaps.

Postoperative survival was 98%. One patient died in the immediate post-operative period and another on postoperative day 7, both for cardiovascular complications.

Table III shows the complications observed in the 92 remaining patients. It was observed a total of 17 complications (24%) in group A and 4 (18%) in group B. The difference was not statistically significant.

All cases of bleeding were successfully submitted to revision surgery. Flap necrosis occurred in 4 jejunum flaps. The necrotic flap was replaced with a PM flap in 3 cases, while in 1 case a second jejunum flap was harvested.

The 4 salivary fistulas occurred in group A patients and were closed with either a rotational sternocleidomastoid muscle flap (2 cases) or a PM flap (2 cases). The salivary fistula in group B was closed with a second PM flap.

The mean hospital stay was 21 days (range 1-32 days) in group A and 20 days (3-35 days) in group B, and the difference was not statistically significant.

Functional analysis was performed on 65 free flaps and 27 pedicled flaps as the 5 patients in group A submitted to revision surgery for removal of the free flap underwent substitution with a PM flap.

The mean permanence of the NG-tube was 13.6 days for group A and 13.7 days for group B; the difference was not statistically significant. The type of feeding at discharge is summarized in Table IV.

**Table I.** Clinical stage.

Stage	No. of patients (%)
III	24 (26)
IV	70 (74)
Total	94 (100)

**Table II.** Type of reconstruction.

Free flap (group A)	No. of patients (%)
Jejunum	58 (83)
Radial forearm (RFF)	9 (13)
Anterolateral thigh (ALT)	3 (4)
Total	70 (100)
Pedicled flap (group B)	No. of patients (%)
Pectoralis major (PM)	22 (92)
Latissimus dorsi (LD)	2 (8)
Total	24 (100)

**Table III.** Post-operative complications.

Type of complication	Group A N (%)	Group B N (%)
Major bleeding	3 (4)	1 (4)
Flap necrosis	4 (6)	0 (0)
Salivary fistula	4 (6)	1 (4)
Dysphagia (PEG)	5 (7)	1 (4)
Total	16 (22)	3 (12)
Minor salivary fistula	1 (1)	1 (4)
Total	1 (1)	1 (4)

**Table IV.** Type of feeding.

Type of feeding	Group A N (%)	Group B N (%)
Normal	52 (80)	0 (0)
Soft	4 (6)	20 (74)
NGA/PEG	9 (14)	7 (26)
Total	65 (100)	27 (100)

Fifty-two (80%) patients in group A and none in group B were able to resume a free diet at discharge. Four (6%) patients in group A and 20 (74%) patients in group B were discharged with a soft diet, 9 (14%) patients in group A and 7 (26%) patients in group B were unable to resume oral feeding and were discharged with a NG-tube or PEG. All the differences between the 2 groups were statistically significant.

None of the 92 patients acquired a satisfactory oesophageal voice. Eleven (17%) of the 65 patients in group A and 2 (7%) of the 27 patients in group B underwent surgical rehabilitation with trachea-oesophageal voice prosthesis. In all cases, trachea-oesophageal puncture was conducted 1 year after the primary surgery.

## Discussion

Reconstruction of the hypopharynx after CPL represents a challenge for the surgeon. In fact, even though conceptually the hypopharynx can be considered a tubular duct, it is actually a complex arrangement of constrictive forces regulated by sensory input that is involved in the pharyngeal phase of swallowing. For this reason, surgical treatment of the hypopharyngeal cancer damages this sensory-motor mechanism and impairs not only swallowing, but also the protective system of the upper respiratory tract.

The goal of reconstruction should aim to restore two main functions, swallowing and phonation, and the type of technique depends on the degree of resection, the patient's general condition and skill of the surgeon.

Disa et al.<sup>2</sup> in 2003 and Urken<sup>4</sup> in 2010 proposed a method of classification of defects of the hypopharyngeal segment after total laryngectomy and partial/total pharyngectomy on which the reconstructive strategy should be based. According to these authors, in type II defects, i.e. circumferential defects extending from the oropharynx to the cervical oesophagus, the "gold standard" is a jejunum flap. This flap, in fact, is already naturally tubulized, the visceral tissue is similar to the hypopharyngeal mucosa and it possesses intrinsic peristalsis. Any difference in size between the transverse diameter of the oropharynx and that of the jejunum flap can be overcome by appropriately shaping the loop, as already proposed by our group<sup>1</sup>.

Disadvantages in the use of this type of flap are represented by the need of two surgical teams and a high risk

of thrombosis of the vascular pedicle with subsequent flap necrosis<sup>5</sup>. Nevertheless, a second jejunum flap can be harvested with prompt re-intervention<sup>6</sup>.

The difficult management of this type of flap has led to the proposal, in the literature, to use other equally thin microvascular flaps, even though not naturally tubulized, such as the RFF or ALT flap. Several authors have demonstrated that these flaps have lower rates of complications and comparable functional results, if not greater, than the jejunum flap<sup>7-9</sup>. These flaps have their limitations: the ALT flap can not be harvested in obese patients because of the excessive thickness of subcutaneous fat; while both the vertical suture, if tubulized, or two vertical sutures, if tunnelized to the prevertebral fascia they can be points of potential weakness and dehiscence<sup>10</sup>.

Pedicled flaps, and in particular the PM flap, should be used as a second choice in patients with general or local contraindications to the use of free flaps. PM is fast and easy to harvest and inset in the neck, but it is too thick, especially if used for circumferential reconstruction, and its gravitational weight can lead to loss of tightness of the sutures with the subsequent onset of salivary fistula<sup>10</sup>.

Our study showed a higher incidence of salivary fistulas in patients reconstructed with free flaps compared to pedicled flaps. Therefore, this difference was not statistically significant, probably because of the difference in the number of the 2 groups. This trend of similar percentages of complications in the 2 groups influenced the duration of hospital stay, leading to similar mean values. For this reason, this is in contrast with literature data that report significant shorter hospital stays for free flaps compared to pedicled flaps<sup>11</sup>.

Results in terms of recovery of swallowing after reconstruction with PM flap are controversial. Some authors have found no significant differences in terms of recovery of free diet in patients undergoing reconstruction with a PM flap compared to those reconstructed with free flaps<sup>12</sup>; others have observed longer periods of NG-tube feeding and more dietary restrictions in reconstructions with pedicled flaps<sup>13,14</sup>. Our experience, and the results of the present study, has shown a higher possibility of restoration of normal feeding with free flaps than with a PM flap<sup>10</sup>.

Nevertheless, the PM flap should be considered first choice in patients with advanced disease, already submitted to previous surgical or organ preservation treatments and in whom life expectancy is low<sup>15</sup>.

If the recovery swallowing function after circumferential resection is obviously required, recovery of vocal function is, wrongly, regarded as secondary, probably because of the low life expectancy of these patients.

We have already demonstrated and confirmed with the present study that oesophageal voice rehabilitation is often impossible for both free and pedicled flaps<sup>10</sup>. Pedicled flaps are usually too thick and stiff to vibrate during the passage of air from the stomach to the mouth, and the je-

jejunum flap does not allow the passage of air for its intrinsic peristalsis and the RFF or ALT flaps, although thin and pliable, requires a high air pressure to vibrate<sup>10</sup>. The shunt between the trachea and the flap, thanks to the high expiratory pressure provided by the lungs, allows the vibration of the walls of free flaps, but it is insufficient to overcome the resistance offered by the walls of the pedicled flap<sup>10</sup>. Our study confirmed this, in fact, as the percentage of patients who benefited from successful surgical voice rehabilitation was 17% in group A and 7% in group B. Voice prosthesis thus represents the only opportunity to restore the capacity of communication in these types of patients<sup>15-20</sup>.

## Conclusions

Free flaps should be considered as the first choice in case of reconstruction of the hypopharynx after CPL because of lower postoperative complications and better functional results. Among these, a jejunum flap best simulates the characteristics of the pharyngeal wall; however, RFF and ALT flaps represent valid alternatives.

The PM flap, due to the increased risk of postoperative complications and less satisfactory functional results, should be reserved only for patients in whom reconstruction with free flaps is not possible or contraindicated.

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Address for correspondence: Federica Mura, Department of Otolaryngology Head Neck Surgery, University of Pavia, IRCCS, Policlinico "S. Matteo" Foundation, v.le Golgi 17, 27100 Pavia, Italy. Tel. +39 347 8716411. Fax +39 0382 528184. E-mail: murafederica@gmail.com