

## ORIGINAL RESEARCH

# Reconstruction of circumferential oro- and hypopharyngeal defects with U-shaped pectoralis major myocutaneous flap

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**OBJECTIVE:** The purpose of the study was to evaluate the effectiveness of a U-shaped pectoralis major myocutaneous flap (PMMF) to reconstruct a large circumferential defect involving the oro- and hypopharynx.

**STUDY DESIGN AND SETTING:** Retrospective case series.

**RESULTS:** Twelve patients with advanced oro- and hypopharyngeal cancer (stage IV) underwent surgery resulting in a circumferential defect of pharyngoesophageal segment (PES). Those defects were reconstructed using a U-shaped PMMF. Four pharyngocutaneous fistulas were observed postoperatively and healed spontaneously within 3 to 7 weeks. Eight patients were able to resume a regular diet. A voice prosthesis was functional in 5 patients.

**CONCLUSION:** This preliminary study shows that this technique is a simple and effective method with acceptable morbidity rate and satisfactory functional results. We demonstrate that this procedure allows the reconstruction of large defects involving the oro- and hypopharynx in irradiated patients. This technique could be an interesting alternative for surgical teams suffering from the absence of a microsurgical team.

**EBM rating: C-4**

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With the progressive development of ablative surgery for pharyngolaryngeal cancer in recent decades, the demand for an effective one-step pharyngoesophageal reconstruction has led to the development of a wide variety of tissue-transfer techniques. Squamous cell carcinoma of the

hypopharynx is one of the most aggressive malignant tumors of the head and neck area and has the worst prognosis.<sup>1</sup> In most cases, hypopharyngeal cancers require an extended radical resection consisting of total laryngectomy combined with partial or total pharyngeal resection. In those extended resections, a reconstructive procedure is required. Reconstruction of the pharynx after circular pharyngolaryngectomy has always presented a technical challenge. Many different solutions have been proposed.<sup>2</sup> The most commonly used procedures are microvascularized free flaps.<sup>3–6</sup> Most frequently, the pectoralis major myocutaneous flap (PMMF) has been used to reconstruct limited hypopharyngeal defect<sup>7</sup> or postsurgical stricture.<sup>8</sup> After circumferential pharyngolaryngectomy, the use of an entirely tubed PMMF was first described by Withers et al.<sup>9</sup> However, the tubed PMMF has some disadvantages (ie, its bulkiness and the risk of stenosis). Because of these problems, Fabian<sup>10</sup> described a procedure where the PMMF was used only for anterior and lateral hypopharyngeal wall reconstruction (in U-shaped) whereas dermal graft is used for the posterior wall. This procedure allowed to reduce the flap thickness and to obtain an adequate lumen caliber. In 2001, Spriano et al<sup>11</sup> described a simplification of this technique using the same procedure but without dermal skin graft for the reconstruction of the posterior wall. We have also used this procedure for carcinomas invading posterior and lateral walls of the oro- and hypopharynx. In those cases, we

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reconstructed this large defect using the modified Fabian technique. The majority of our patients presented a recurrence after radiotherapy or concomitant chemoradiotherapy. Our functional results show that the modified Fabian technique allows the reconstruction of a large circumferential defect involving the oropharynx and the hypopharynx, even in irradiated patients.

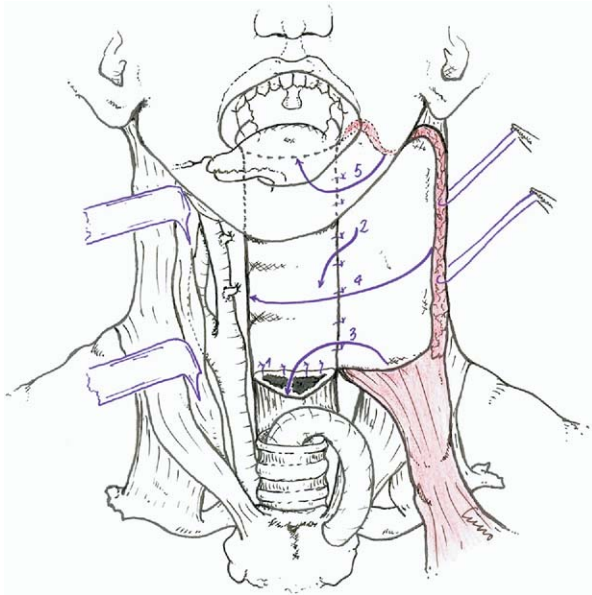
## METHODS

Between January 2000 and April 2005, 12 patients with advanced oro- and hypopharyngeal carcinomas were included in this study. This retrospective study was accepted by the local Institutional Review Board. All of the patients were men between 45 and 63 years old with a

**Table 1**  
**Patient characteristics**

Patient	Age	Localization of tumor	TNM	Pre-operative treatment	Doses of radiotherapy	Extension of the resection
1	47	Oro + hypopharynx	T4N1M0	RX	66 gy	Circular pharyngectomy + base of the tongue + bilateral functional neck dissection
2	55	Hypopharynx	T4N0M0	Rx + Ch	70 gy	Circular pharyngectomy + bilateral functional neck dissection
3	55	Hypopharynx	T4N0M0	Rx	Radical neck dissection + 70 gy	Circular pharyngectomy + unilateral functional neck dissection
4	57	Oro + hypopharynx	T4N1M0	Rx	70 gy	Circular pharyngectomy + posterior and lateral walls of oropharynx + bilateral functional neck dissection
5	58	Oro + hypopharynx	T4N0M0	Rx	70 gy	Circular pharyngectomy + posterior and lateral walls of oropharynx + bilateral functional neck dissection
6	53	Oro + hypopharynx	T4N1M0	Con Rx + Ch	70 gy + Cis + 5 F-U	Circular pharyngectomy + base of the tongue + bilateral functional neck dissection
7	45	Oro + hypopharynx	T4N0M0	Con Rx + Ch	70 gy + Cis + 5 F-U	Circular pharyngectomy + posterior and lateral walls of oropharynx + bilateral functional neck dissection
8	63	Hypopharynx	T4N0M0	—	70 gy post op	Circular pharyngectomy + unilateral radical neck dissection
9	56	Hypopharynx	T4N0M0	Rx for thyroid carcinoma	Not known	Circular pharyngectomy
10	54	Oro + hypopharynx	T4N0M0	—	Cis + 5 F-U	Circular pharyngectomy + base of the tongue + bilateral functional neck dissection
11	46	Hypopharynx	T4N0M0	Rx	70 gy	Circular pharyngectomy + bilateral functional neck dissection
12	55	Hypopharynx	T4N1M0	Con Rx + Ch	70 gy + Cis + 5 F-U	Circular pharyngectomy + bilateral radical and functional neck dissection

Ch, chemotherapy; Rx, radiotherapy.



**Figure 1** Schematic drawing of the reconstructive procedure using the pectoralis major myocutaneous flap.

mean age of 54 years. To allow a detailed assessment of the tumor and to rule out synchronous primary disorders, all patients underwent 1) a computed tomographic (CT) scan of the head and neck, and 2) staging endoscopy. Chest CT scan, abdominal ultrasound, and bone scans were used routinely to rule out distant metastasis before any recommendation for surgery was made. The histological diagnosis was squamous cell carcinoma in all cases, except for 2 where the pathologist did not find any

trace of tumor cells. According to the staging system of the American Joint Committee on Cancer,<sup>12</sup> all patients were categorized as having stage IV tumors originating from the oro- or hypopharynx (Table 1).

### Surgical Approach

The method of reconstruction we used is applicable to patients presenting an advanced cancer of the posterior and lateral walls of the oro- and hypopharynx requiring a circumferential pharyngolaryngectomy. After the tumor was removed, a pharyngeal tube between the nasopharyngeal and the oesophageal stumps was reconstructed. *Step one:* the posterior free edge of the oesophageal stump was sutured to the prevertebral fascia, to avoid stenosis or stricture formation (ideally the right-handed surgeon would stand at the left side of the patient and use the left PMMF for reconstruction). *Step two:* the PMMF was sutured from top to bottom on the left side to the prevertebral fascia. *Step three:* the PMMF was sutured to the remaining free edge of the oesophageal stump. *Step four:* the PMMF was sutured to the prevertebral fascia on the right side, working from bottom to top. *Step five:* the upper extremity of the PMMF was sutured from left to right. The remaining left part of the pharyngeal tonsil was sutured first, followed by the base of the tongue. We ended up at the right pharyngeal tonsil (Fig 1). No salivary bypass was used during the procedure. No X-ray was used to test the integrity of the suture line before feeding the patient. The first attempt of swallowing was realized with water 10 days after the surgery. We used the Provox® voice prosthesis (Atos Medical, Hörby, Svède) in this series.

**Table 2**  
**Functional results**

Patients	Age	Localization of tumor	Pre-operative treatment	Oral feeding	Early complication	Late complication	Duration of hospitalization
1	47	Hypopharynx	—	J13		Bilateral paralysis of hypoglossal nerve	23
2	55	Hypopharynx	Rx + Ch	J40	Fistula J18		40
3	55	Hypopharynx	Rx	J47	Fistula J19		37
4	57	Oro + hypopharynx	Rx	J25			28
5	58	Hypopharynx	Rx	J20		Multiple dilatations	23
6	53	Oro + hypopharynx	Rx	J24		Bilateral paralysis of hypoglossal nerve	35
7	45	Oro + hypopharynx	Rx	J18	Fistula J8		23
8	63	Hypopharynx	—	J14			23
9	56	Hypopharynx	Rx	J12			28
10	54	Hypopharynx	Rx for thyroid carcinoma	J55	Fistula J7	Multiple dilatations	55
11	46	Hypopharynx	Rx	J18			23
12	55	Hypopharynx	Rx + Ch	J15			20

Ch, chemotherapy; Rx, radiotherapy.

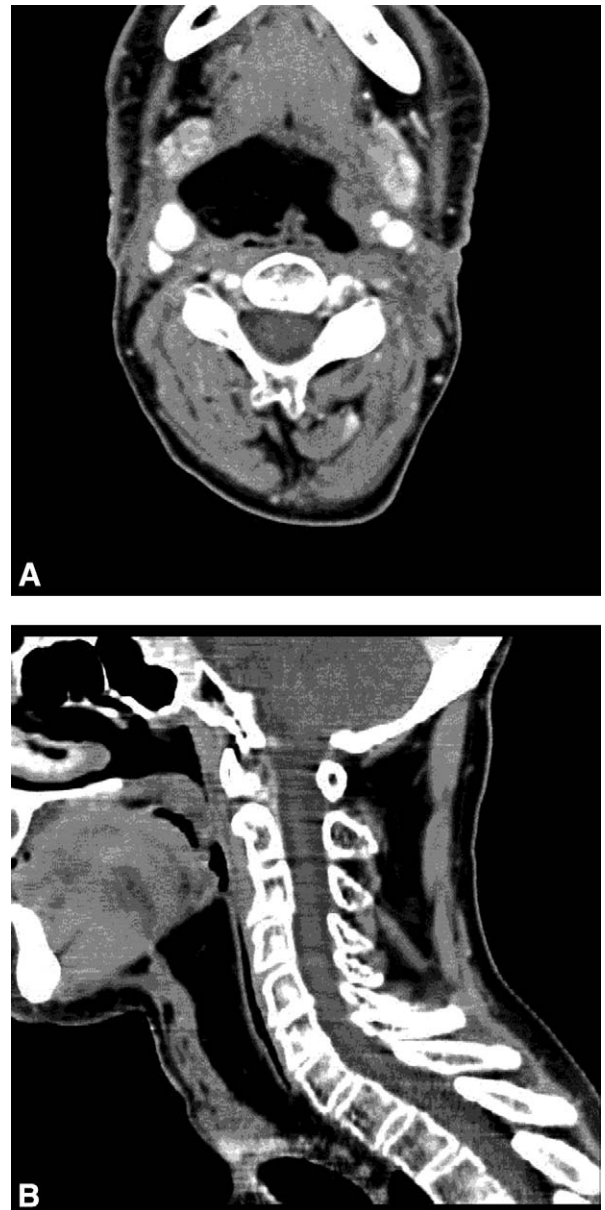
## RESULTS

The operating time of this technique was almost the same as that of a reconstruction of partial hypopharyngeal defect with PMMF. The mean operating timing was 1 hr 30 min (1 to 2 hr). There were no surgery-related post-operative deaths. The preoperative treatments, the staging of the tumor and the precise limits of the resection are summarized in [Table 1](#). Our study is composed of recurrences (10 of 12 cases) encountered after either radiotherapy or concomitant chemoradiotherapy. Half of our patients underwent very large resection extended to the oropharynx (ie, base of the tongue, posterior, and lateral walls). Among those patients, most needed this resection because of the presence of large carcinoma invading the oro- and hypopharynx. Patient 5 required such a resection because he presented synchronous carcinomas of the tonsil and the hypopharynx.

There were no general complications. The postoperative wound healing was good. Four pharyngocutaneous fistulas occurred but all closed up with a medical treatment consisting only of water rinsing of the fistula. [Table 2](#) indicates the functional results and shows that all fistulas concerned irradiated patients. [Table 2](#) also shows that the 2 non-irradiated patients presented the shortest postoperative time before oral feeding was restored. The postoperative swallowing function was satisfactory. Eight patients were able to eat regular food and the other 4 patients could eat soft food. Among those 4 patients, 2 needed several dilations of the reconstructed segment due to a stenosis ([Table 3](#)). The minimal follow-up period of 12 months could suggest that these number of stenosis is definitive. Three patients suffered from hypoglossal nerve paralysis due to the resection and among these, 1 presented bilateral hypoglossal paralysis causing permanent swallowing problems. [Figure 2](#) shows axial ([Fig 2A](#)) and sagittal ([Fig 2B](#)) CT scans of the pharyngoesophageal segment reconstructed using the method described above, and illustrates a good functional result in a patient requiring oro- and hypopharyngeal resection.

Tracheoesophageal puncture for the placement of a prosthesis was carried out in 6 patients and 5 were functional ([Table 4](#)). Among those patients, 4 had been irradiated preoperatively.

The surgical resection margins were all tumor-free. We treated 22 necks, of which there were 20 functional neck dissections (levels I to V) and 2 radical neck dissections. The neck lymph nodes were removed from 11 patients. All



**Figure 2** Axial (A) and sagittal (B) CT scans showing the reconstructed pharyngoesophageal segment.

the excised lymph nodes were examined and the histology was: pN– in 4 cases, pN+ in 7 cases. Follow-up of the 12 patients has been from 12 to 30 months (mean, 21 months). Currently, 5 patients have died because of tumors (4 recurrences and 1 case of lung metastases).

### Case Report

This type of circumferential reconstruction was applied to a 60-year-old patient whose primary tumor persisted despite radiotherapy for squamous cell carcinoma of the posterior and lateral oropharyngeal walls extending to the posterior wall of the hypopharynx. This lesion required a circumferential pharyngolaryngectomy, with resection reaching the posterior and lateral oropharyngeal walls. The primary tumor excision included the 2 inferior poles of the tonsils. We

**Table 3**  
**Local complications**

	Patients (n)	%
Salivary fistula	4	33
Spontaneous closure	4	100
Stricture	2	16



**Table 4**  
**Tracheoesophageal prosthesis**

Patients	Localization of tumor	Tracheoesophageal prosthesis	Functional prosthesis
1	Hypopharynx		
2	Hypopharynx		
3	Hypopharynx		
4	Oro + hypopharynx	No	Yes <sup>+</sup>
5	Hypopharynx	Yes	Yes
6	Oro + hypopharynx		
7	Oro + hypopharynx	Yes	Yes
8	Hypopharynx	Yes	No
9	Hypopharynx	Yes	Yes
10	Hypopharynx	Yes	Yes
11	Hypopharynx	Yes	Yes
12	Hypopharynx		

<sup>+</sup>Using the Bloom voice-simulator, 1 patient presented an excellent voice but he refused the placement of this prosthesis after reading the information concerning the possible side effects of this procedure.

applied the same reconstructive technique as described previously. The postoperative follow-up was uneventful and the swallowing function satisfactory. The patient was able to eat correctly with a normal diet. He even gained 10 kg during the first 6 months after the surgery. Control fiberoptic endoscopy used for the removal of the gastrostomy tube showed no stricture formation. CT scans (Fig 2) and videofluoroscopy (Fig 3) show the neopharyngoesophageal segment reconstructed by this method 12 months after this procedure was carried out.

## DISCUSSION

The poor prognosis of oro- and hypopharyngeal cancers is due to the late diagnosis of an already advanced tumor.



**Figure 3** Videofluoroscopy showing the swallowing conduit after reconstruction.

Eighty percent of patients presenting hypopharyngeal carcinoma are categorized as stage III or IV. Those advanced lesions are treated most frequently by concomitant radio-chemotherapy whereas wide surgical resections are reserved for recurrences. Head and neck surgeons are confronted with large defects of the pharyngoesophageal segment (PES) in a post-chemoradiotherapy context. After such debilitating treatment, the emaciated patient presenting a recurrence in a context of poor general health needs a safe, fast, and minimally-invasive salvage surgery.

Reconstruction of a circumferential hypopharyngeal defect is still a challenge to head and neck surgeons, especially when this is done in a post-chemoradiotherapy context. Many reconstructive procedures have been described, including pedicled flaps, stomach transposition, and free forearm or jejunum grafts. Some of these techniques are not only technically complex but also time-consuming and most frequently require an additional surgical team. An increasing number of surgeons consider free jejunal interposition as the first reconstructive option for circular pharyngeal defects.<sup>3-6</sup> This procedure has demonstrated a high rate of successful restoration of deglutition with an acceptable rate of fistula and stricture.<sup>3-6,3-16</sup> Julieron et al<sup>4</sup> described fistulas in 14% of cases, flap failures in 5% of cases, and patients eating solid or soft food in 98% of cases. However, this procedure presents some disadvantages: 1) 2 surgical teams are necessary to perform this long procedure; and 2) a laparotomy is needed to harvest the graft, with abdominal complications in 8% to 13% of cases.<sup>4</sup> In 2003, Disa et al<sup>6</sup> described an excellent algorithm for hypopharyngeal reconstruction in 165 consecutive patients. In this study, the overall free tissue transfer survival rate was 98% and the overall fistula rate was 7%.

A comparison between the jejunal free flap and the radial forearm flap clearly establishes that significantly more fistulas (15 vs 3) and strictures (13 vs 6) were observed in the latter group.<sup>17</sup> The Julieron team considered the free jejunal flap as the first choice for total reconstruction of pharyngo-oesopha-

geal defects and proposed the forearm flap for elderly, high risk patients, because it is less invasive and has minimal donor site morbidity and therefore facilitates quick recovery. Using the free forearm flap, Kelly et al<sup>17</sup> demonstrated that salivary leakage was high, especially with tubed flaps. In a retrospective study using the radial forearm free flap on 20 consecutive patients, Varvares et al<sup>18</sup> described pharyngocutaneous fistula in 20% of cases and postoperative stricture in 10% of cases. Azizzadeh et al<sup>19</sup> described similar results; they encountered postoperative fistula and distal stricture in 20% of patients in a retrospective series including 20 patients. The radial forearm free flap presents the advantage of avoiding laparotomy. This procedure has the disadvantage of requiring a microvascular team and of provoking a high rate of fistulas and stricture.

Gastric transposition also permitted the reconstruction of the circumferential defect of the hypopharynx. However, most head and neck surgeons reserved total pharyngolaryngo-oesophagectomy for more extensive disease with oesophageal involvement.<sup>20</sup> Jones et al<sup>20</sup> showed that in case of salvage surgery, this procedure is associated with a high rate of complications (12 of 18 patients, notably 2 carotid blow-outs and 4 flap necroses).

Several studies have demonstrated that the PMMF could be an option to reconstruct circular pharyngeal defects. Most head and neck surgeons used PMMF (sometimes doing it themselves) for the reconstruction of partial pharyngectomy with laryngectomy. In this regard, Theogaraj et al<sup>8</sup> reported the use of partially tubed PMMF over preserved posterior wall cervical esophageal mucosa in cases of short-segment stenosis. Encouraged by those results, Fabian<sup>10</sup> described a procedure where the PMMF is used only for anterior and lateral hypopharyngeal wall reconstruction, whereas dermal graft is used for the posterior wall. He reported 6 fistulas and 1 total graft failure in a group of 17 patients (7 of 17 had undergone preoperative radiotherapy). In 2001, this technique was then simplified by Spriano<sup>11</sup> who carried out the same procedure, but without dermal skin graft, for the reconstruction of the posterior wall. This modified procedure exhibited excellent functional results, as only 3 fistulas and 2 cases of poor swallowing status were observed in a group of 22 patients. Among these patients, only 6 had been irradiated preoperatively and the defect concerned the hypopharynx without involvement of the oropharynx. One year later, the same team described the results of the PMMF in a series of 37 patients affected by advanced hypopharyngeal cancer. This larger series including 22 cases of total pharyngolaryngectomy and 15 cases of subtotal pharyngolaryngectomy showed neither flap necrosis nor strictures and only 5 pharyngeal fistulas.<sup>21</sup> In 2005, Morshed et al<sup>22</sup> used the same procedure to close circumferential defects in 11 patients. They obtained good healing in 6 patients whereas 5 patients developed fistula that closed spontaneously within 3 to 4 weeks.<sup>22</sup>

Our surgical technique is quite similar to the one described by Fabian<sup>10</sup> and modified by Spriano et al.<sup>21</sup> The main tech-

nical difference is that we do not use a salivary bypass. In comparison with the Spriano study,<sup>21</sup> our cases present 2 distinctive features: 1) most of our patients were first treated with radiotherapy or concomitant chemoradiotherapy; and 2) half of our patients underwent circular pharyngolaryngectomy associated with a partial resection of the oropharynx. Despite those larger defects and the post-chemoradiotherapy context, we observed an acceptable rate of fistula and stricture. We encountered fistulas in 33% of our cases whereas Fabian<sup>10</sup> found fistulas in 35% of his cases. The most important feature concerning this healing problem is that no patients needed a second surgical procedure because every fistula closed with a conservative treatment. Moreover, this technique authorizes the use of a functional voice prosthesis in a significant number of patients. Five irradiated patients used their Provox® voice prosthesis satisfactorily. In this regard, Deschler et al<sup>23</sup> realized the quantitative and qualitative analysis of the tracheoesophageal voice after pharyngolaryngectomy repaired using PMMF. They demonstrated that dependable voice was attainable after this kind of reconstruction and that, in terms of acoustic parameters, the character of such voice does not differ significantly from voice after standard laryngectomy.<sup>23</sup>

In conclusion, we believe that the PMMF allows an adequate reconstruction of the oro- and hypopharynx. However, we emphasize that our study presents some limitations due to the study design. This is a small, retrospective series with inherent biases. We propose to realize a prospective study with a longitudinal evaluation of patients who have undergone this reconstruction. This technique is simple, effective, and could be an interesting alternative for surgical teams suffering from the absence of a microsurgical team. Indeed, the same team can remove the tumor and then perform the reconstruction in a single intervention. The direct suture of the musculocutaneous flap to the prevertebral fascia simplifies this reconstruction (avoiding dermal graft and sparing donor site pain) and shortens operating time in patients already affected by a poor-prognosis oncologic disease and other concomitant chronic systemic disorders. However, this technique does not replace the free jejunal flap that remains the best surgical procedure to reconstruct complex pharyngeal defect.

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