Free Jejunal Patch Graft for Reconstruction After Partial Hypopharyngectomy With Laryngeal Preservation

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Objectives: To examine postoperative complications and swallowing function associated with free jejunal patch graft transfer after partial hypopharyngectomy with laryngeal preservation.

Design: Retrospective medical record review.

Setting: Academic research.

Patients: A consecutive series of 43 patients who underwent free jejunal patch graft transfer after partial hypopharyngectomy with laryngeal preservation composed the study sample. They represented the following 3 groups based on the type of hypopharyngeal defect: 13 patients with defects of the posterior wall (PW group), 28 patients with defects extending to the unilateral piriform sinus (PS-PW group), and 2 patients with defects extending to the bilateral piriform sinuses (PS-PS group).

Main Outcome Measures: Postoperative complications and oral intake ability were compared among the groups.

Results: Except for 1 patient, all the patients in the PW and PS-PS groups resumed oral intake within 2 weeks after surgery. Four patients in the PS-PW group had severe dysphagia, 2 of whom could not discontinue tube feeding.

Conclusions: Free jejunal patch graft transfer after partial hypopharyngectomy allows satisfactory swallowing function, with a low complication rate. Postoperative dysphagia was slightly more common in the PS-PW group than in the PW group.


ALTHOUGH TOTAL PHARYNGOLARYNGECTOMY has long been the standard treatment for locally advanced hypopharyngeal cancer, partial hypopharyngectomy with laryngeal preservation has recently become possible, and its indications have steadily been expanding for selected patients.1-6 Reconstruction after partial hypopharyngectomy with laryngeal preservation is a challenging problem because of the risk of postoperative aspiration. Free jejunal patch graft (FJPG) transfer is widely accepted as the method of first choice for reconstruction6-8; however, few investigations have examined postoperative complications and swallowing function. Furthermore, the relationship between postoperative functional results and defect type remains unclear. In the present retrospective study, we examined clinical results (including postoperative complications and swallowing function by defect type) of FJPG transfer after partial hypopharyngectomy with laryngeal preservation.

METHODS

Forty-three patients with hypopharyngeal cancer underwent FJPG transfer immediately after partial hypopharyngectomy with laryngeal preservation at the National Cancer Center Hospital East, Kashiwa, Japan, from December 9, 1992, through June 20, 2008, and were included in the study. The patients were 37 men and 6 women who had a mean (SD) age of 62.3 (8.2) years. Thirty-nine patients had primary cancer and 4 had recurrent cancer after initial treatment. Among those with primary cancer, 7 patients were classified as having stage I; 24, as having stage II; 6, as having stage III; and 2, as having stage IV according to the TNM Classification of Malignant Tumours7 (Table 1).

SURGICAL TECHNIQUES

A segment of jejunum approximately 15-cm long was harvested in the usual manner. After a small segment of jejunum to be exteriorized for postoperative monitoring had been prefabricated, the remaining segment of jejunum was trimmed on the oral and anal sides by referring to the longitudinal length of the resected
specimen (Figure 1). The jejunum was then opened along the antimesenteric border and transferred to the hypopharyngeal defect in an isoperistaltic fashion and fixed with 4-0 monofilament absorbable sutures. First, the jejunum was sutured where a suture is the most difficult to place, which is usually the most caudal point on the side opposite the surgeon. Next, the jejunum was sutured in sequence to the posterior, caudal, and cranial margins with a single-layer inverting interrupted suture (Figure 2). Finally, the anterior margin was closed with a Gambee suture. The jejunum was set into the defect under in situ tension, and the redundant portion of the jejunum was appropriately trimmed. After mucosal closure was completed, a microvascular anastomosis was performed between the jejunal pedicle and the cervical vessels.

EVALUATION

The medical records of 43 patients were examined to analyze the following variables: patient history, defect type, postoperative recipient site complications, postoperative course, and oral intake ability. Postoperative recipient site complications analyzed were total necrosis of the FJPG, fistula formation, and surgical site infection.

Patients were classified into the following 3 groups based on the type of hypopharyngeal defect: patients with defects of the posterior wall (PW group), patients with defects extending to the unilateral piriform sinus (PS-PW group), and patients with defects extending to the bilateral piriform sinuses (PS-PS group) (Figure 3).

Barium swallow examinations were performed 7 to 10 days after surgery. If the examination revealed no leakage and no significant aspiration, the patient was allowed to start oral intake. If leakage or severe aspiration was present, the examination was repeated 7 days later. The number of days after surgery until the start of oral intake was noted. For patients who had undergone tracheostomy, the number of days until closure of the tracheal stoma was also recorded.

Postoperative swallowing function was indicated by the type of diet the patient could tolerate after recovery and before disease progression (100% oral diet, partial oral diet, or 100% tube diet). If leakage or severe aspiration was present, the examination was repeated 7 days later. The number of days after surgery until the start of oral intake was noted. For patients who had undergone tracheostomy, the number of days until closure of the tracheal stoma was also recorded.

Postoperative swallowing function was indicated by the type of diet the patient could tolerate after recovery and before disease progression (100% oral diet, partial oral diet, or 100% tube diet).

**Table 1. TNM Classification Among 39 Patients**

<table>
<thead>
<tr>
<th>Stage</th>
<th>N0</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>T2</td>
<td>13</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>T3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>T4</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>8</td>
<td>9</td>
<td>3</td>
<td>39</td>
</tr>
</tbody>
</table>

*According to the TNM Classification of Malignant Tumours.*

Four patients had recurrent cancer.
feeding). Background and postoperative course were analyzed in patients who could not resume oral intake within 2 weeks after surgery.

**STATISTICAL ANALYSIS**

Statistical analysis was performed between the PW and PS-PW groups using a commercially available software program (Statcel, version 2; OMS Publishing, Saitama, Japan). The PS-PS group was excluded from statistical analysis because the sample size was too small. The Fisher exact, unpaired t, and Mann-Whitney tests were used. Differences with \( P < 0.05 \) were considered statistically significant.

**RESULTS**

Pathological diagnosis was squamous cell carcinoma in 40 patients and adenosarcoma, endocrine carcinoma, and spindle cell carcinoma in 1 patient each. The median follow-up period was 39.9 months, and 17 patients (40%) were alive without recurrence at the time of study completion.

Patient data are summarized in Table 2. Hypopharyngeal defects were of the PW type in 13 patients, the PS-PW type in 28 patients, and the PS-PS type in 2 patients. In all the patients, the cartilaginous prominence of the arytenoepiglottic fold was preserved. No significant differences were noted in age ratio or sex ratio between the PW and PS-PW groups. One patient in the PW group (8%) and 7 patients in the PS-PW group (25%) received radiotherapy to the neck. Two of these patients in the PS-PW group had received concomitant chemotherapy.

Complication rates are given in Table 3. There were no significant differences in the overall complication rate or the rates of total necrosis of the FJPG, fistula formation, or surgical site infection between the PW and PS-PW groups. Total necrosis of the FJPG occurred in 1 patient in the PW group (8%) and in 1 patient in the PS-PW group (4%). Pharyngocutaneous fistulas developed in 3 patients in the PS-PW group (11%) but healed with conservative treatment. No pharyngocutaneous fistulas developed in patients in the PW group. No complications developed in patients in the PS-PS group.

**POSTOPERATIVE RECipient SITE COMPLICATIONS**

Postoperative course and oral intake ability by defect type are summarized in Table 4 and Table 5. Oral intake could be resumed within 2 weeks after surgery in all patients in the PW and PS-PS groups except for 1 patient with total necrosis of the FJPG. She underwent salvage surgery by external fistula formation using a deltopectoral flap. Multiple operations were required to close the external fistula, and she could not start an oral diet until 75 days after the first surgical procedure. In the PS-PW group, 5 patients could not resume oral intake within 2 weeks after surgery. Four of the patients experienced severe aspiration, and the fifth patient (with total necrosis of the FJPG who underwent successful salvage surgery) could not resume oral intake within 2 weeks after surgery.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>PW Group (n=13)</th>
<th>PS-PW Group (n=28)</th>
<th>PS-PS Group (n=2)</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, No. of patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>25</td>
<td>2</td>
<td>.36</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>.36</td>
</tr>
<tr>
<td>Age, mean, y</td>
<td>58.8</td>
<td>63.5</td>
<td>67.0</td>
<td>.09 b</td>
</tr>
<tr>
<td>Follow-up period, mean, mo</td>
<td>28.6</td>
<td>26.8</td>
<td>80.5</td>
<td>.85 b</td>
</tr>
<tr>
<td>History of RT or CRT, No. of patients (radiotherapy dose range, Gy)</td>
<td>1 (59)</td>
<td>7 (40-70)</td>
<td>0</td>
<td>.19</td>
</tr>
</tbody>
</table>

Abbreviations: CRT, chemoradiotherapy; PS-PS, defect extending to the bilateral piriform sinuses; PS-PW, defect extending to the unilateral piriform sinus; PW, defect of the posterior wall; RT, radiotherapy.

*Comparison between the PW and PS-PW groups using the Fisher exact test unless otherwise indicated.

b Using unpaired t test.
by transfer of an anterolateral thigh flap) started an oral diet 17 days after the first surgical procedure. The number of days until the start of oral intake did not differ significantly between the PW and PS-PW groups.

Temporary tracheostomies were created at the time of surgery in 38 patients, and all were closed after surgery. The number of days until closure of the tracheal stoma did not differ significantly between the PW and PS-PW groups. However, in the PS-PS group, the time until closure was longer than in the other groups.

Overall, 41 of 43 patients (95%) were eventually able to tolerate an oral diet without the need for tube feeding. All the patients in the PW and PS-PS groups tolerated a 100% oral diet, whereas of 28 patients in the PS-PW group, 26 patients (93%) tolerated a 100% oral diet and 2 patients (7%) could not discontinue tube feeding. The rate of dependence on tube feeding did not differ significantly between the PW and PS-PW groups. Four patients underwent postoperative adjuvant radiotherapy because of a microscopically involved mucosal margin of resection or extranodal spread of disease. They were able to tolerate oral intake after radiotherapy.

The background and postoperative course of patients with severe dysphagia and aspiration pneumonia who could not start oral intake for more than 2 weeks after surgery are listed in Table 6. Two patients had personality disorders and were not adherent to our instructions about swallowing rehabilitation; they finally started oral intake 42 and 45 days after surgery. The other 2 patients had a history of esophageal disease and were 70 years or older. One of these patients had undergone endoscopic balloon dilation 3 times for idiopathic upper esophageal stenosis. The other patient had undergone subtotal esophagectomy for esophageal cancer and reconstruction with retrosternal gastric pull-up. Postoperative videofluorographic studies in these 2 patients showed

<table>
<thead>
<tr>
<th>Postoperative Event</th>
<th>PW Group (n=13)</th>
<th>PS-PW Group (n=28)</th>
<th>PS-PS Group (n=2)</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiation of oral intake</td>
<td>11 (6-75)</td>
<td>11 (6-73)b</td>
<td>13 (11-14)</td>
<td>.92</td>
</tr>
<tr>
<td>Closure of tracheal stoma</td>
<td>13 (8-75)</td>
<td>13 (11-112)</td>
<td>21 (18-24)</td>
<td>.78</td>
</tr>
</tbody>
</table>

Abbreviations: PS-PS, defects extending to the bilateral piriform sinuses; PS-PW, defects extending to the unilateral piriform sinus; PW, defects of the posterior wall.

b The patient who could not discontinue tube feeding was excluded.

<table>
<thead>
<tr>
<th>Method of Nutrition</th>
<th>PW Group (n=13)</th>
<th>PS-PW Group (n=28)</th>
<th>PS-PS Group (n=2)</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Oral diet</td>
<td>13 (100)</td>
<td>26 (93)</td>
<td>2 (100)</td>
<td>.32</td>
</tr>
<tr>
<td>Partial oral diet</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>100% Tube feeding</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: PS-PS, defects extending to the bilateral piriform sinuses; PS-PW, defects extending to the unilateral piriform sinus; PW, defects of the posterior wall.

a Comparison between the PW and PS-PW groups using the Fisher exact test.

<table>
<thead>
<tr>
<th>Sex/Age, y</th>
<th>Comorbidity</th>
<th>Previous Treatment</th>
<th>Initiation of Oral Intake</th>
<th>Closure of Tracheal Stoma</th>
<th>Method of Nutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/59</td>
<td>Personality disorder</td>
<td>None</td>
<td>42</td>
<td>12</td>
<td>100% Oral diet</td>
</tr>
<tr>
<td>M/60</td>
<td>Personality disorder after cerebral contusion</td>
<td>60-Gy RT</td>
<td>45</td>
<td>16</td>
<td>100% Oral diet</td>
</tr>
<tr>
<td>F/70</td>
<td>Upper esophageal stenosis, with 3 endoscopic balloon dilations</td>
<td>None</td>
<td>73</td>
<td>23</td>
<td>Partial oral diet</td>
</tr>
<tr>
<td>M/74</td>
<td>Esophageal cancer, with subtotal esophagectomy and reconstruction with retrosternal gastric pull-up</td>
<td>None</td>
<td>Impossible</td>
<td>112</td>
<td>100% Tube feeding</td>
</tr>
</tbody>
</table>

Abbreviations: PS-PW, defects extending to the unilateral piriform sinus; RT, radiotherapy.
severe obstruction at the esophageal orifice and aspiration during laryngeal elevation. One of the patients resumed oral intake 73 days after surgery but remained partially dependent on tube feeding. The other patient could not resume oral intake and continued tube feeding.

COMMENT

This study demonstrated that satisfactory swallowing function with a low complication rate can be achieved with FJPG transfer for reconstruction of defects after partial hypopharyngectomy with laryngeal preservation. Neither the complication rate nor postoperative swallowing function was significantly affected by defect type; however, postoperative dysphagia was slightly more common in the PS-PW group than in the PW group.

Various methods have been used for reconstruction after partial hypopharyngectomy.1,2,4,6,10-13 Recently, radial forearm free flap transfer and FJPG transfer have become the 2 most popular methods of reconstruction. Some surgeons prefer radial forearm free flap transfer because of its minimal invasiveness and good accessibility1,2,4,6,10; however, the substantial risk of fistula formation is a major disadvantage of the radial forearm free flap.6,10 In addition, the absence of self-lubrication in the skin flap impairs swallowing function.6 Several years ago, we routinely used radial forearm free flaps, as well as FJPGs, for reconstruction after partial hypopharyngectomy, but we have stopped using radial forearm free flaps because of their high complication rate. The use of FJPGs for head and neck reconstruction was first reported by Buckspan et al11 in 1986. Nakatsuka et al6 used the FJPG for reconstruction after partial hypopharyngectomy with laryngeal preservation and demonstrated its superiority to the radial forearm free flap. The advantages of FJPG are a low rate of fistula formation and favorable passage of food because of its self-lubricating surface. A major disadvantage is the need for laparotomy; however, it was previously shown that FJPGs can be safely harvested even in patients who are older or who have undergone abdominal surgery.14 Another concern with the FJPG is aspiration of mucus secretions from the jejunum. Giovannoli et al12 reported that the volume of jejunal secretions increases markedly in the early phase after free jejunal transfer. However, aspiration pneumonia, which can result from jejunal secretions, did not develop in any patient in the present series. When the supraglottic structure of the larynx has been preserved, aspiration of jejunal secretions does not seem to be a problem.

The results of the present study show that patients with PW defects are strong candidates for reconstruction by FJPG transfer. However, 4 patients in the PS-PW group experienced severe aspiration. A possible reason is that proximity of the defect to the larynx prolonged laryngeal edema and impaired hypopharyngeal clearance. However, swallowing dysfunction in our patients could not be directly attributed to the extent of the defects. Two patients had personality disorders, and the other patients had a history of esophageal disease. In addition, the 2 patients who could not discontinue tube feeding were 70 years or older. The other patients in the PS-PW group with neither personality disorders nor a history of esophageal disease resumed oral feeding within 2 weeks. In addition to advanced age, which is known to have an adverse effect on laryngeal preservation,15,16 personality disorders and a history of esophageal disease are, we believe, limiting factors for laryngeal preservation.

The major consideration when reconstructing a PS-PW defect is whether to restore the anatomical shape of the piriform sinus or to reconstruct a narrow pharyngeal space with a taut jejunum. In the present series, we transferred the jejunum under in situ tension and obtained satisfactory results. In contrast, some authors have suggested that the transferred jejunum should be taut because pooling of food at the affected side becomes problematic when the jejunum is transferred under low tension.1 However, postoperative videofluorographic studies of our patients with severe dysphagia showed pooling of the contrast medium on the healthy side but not on the affected side. We believe that tautness of the transferred jejunum is minimally important for this type of reconstruction and that transfer of the jejunum under tight tension is unnecessary. Of course, formation of a blind loop should be prevented; however, this rarely occurs unless the FJPG transferred is much larger than the resected specimen.

In this series, 2 patients in the PS-PS group were successfully treated and tolerated an oral diet without severe aspiration. However, we believe that patients with this type of defect are not good candidates for laryngeal preservation and that total pharyngolaryngectomy should be the standard treatment. The outcome of laryngeal preservation and FJPG transfer for such wide defects is unknown because our sample size was too small to address this issue.

The use of intensive organ preservation therapy is considered a standard option for hypopharyngeal cancer, with surgery reserved for salvage. However, we believe that radiotherapy or chemoradiotherapy should not be the first-line treatment for small hypopharyngeal cancer because of the high risk of second primary cancer of the aerodigestive tract in these patients. Hypopharyngeal cancer is generally treated with wider-field radiation therapy than is used for laryngeal cancer, which renders the treatment more difficult in case of second primary head and neck cancer. From the functional point of view, the results of this study compare favorably with those of organ preservation therapy.17,18 Therefore, we choose operative treatment as a first choice for small hypopharyngeal cancer that can be resected with laryngeal preservation.

A limitation of FJPG transfer is that it is not indicated for defects extending to the supraglottic region. Reconstructing an arytenoepiglottic fold of appropriate height after partial pharyngolaryngectomy is important to prevent postoperative aspiration.6 However, reconstructing the complex supraglottic structures with an FJPG is difficult because of its minimal plasticity. In addition, jejunal secretions can cause frequent aspiration if the internal wall of the larynx is reconstructed with a jejunal graft. Therefore, we use a radial forearm free flap instead of an FJPG for reconstruction after partial pharyngolaryngectomy.
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Author Contributions: Drs Miyamoto, Sakuraba, Hayashi, Ebihara, Miyazaki, Daiko, Shinozaki, and Kimata had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Miyamoto, Sakuraba, Hayashi, and Kimata. Acquisition of data: Miyamoto, Sakuraba, Asano, Ebihara, Miyazaki, Daiko, and Shinozaki. Analysis and interpretation of data: Miyamoto and Sakuraba. Drafting of the manuscript: Miyamoto, Asano, Hayashi, Ebihara, Miyazaki, Daiko, and Shinozaki. Critical revision of the manuscript for important intellectual content: Sakuraba and Kimata. Administrative, technical, and material support: Miyamoto, Sakuraba, Asano, Ebihara, Miyazaki, Daiko, and Shinozaki. Study supervision: Sakuraba, Hayashi, and Kimata.

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REFERENCES


