



## Polytetrafluoroethylene (Gore-Tex) tube used as a support conduit in open gastrostomy: Report of a new technique

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### ABSTRACT

**Background:** When percutaneous endoscopic gastrostomy (PEG) or percutaneous radiographic gastrostomy (PRG) are not possible or fail, surgical gastrostomy would be the convenient method. Stamm's procedure has increasingly replaced other methods of surgical gastrostomy (SG). However, this procedure has various complications. In this study we used a Gore-Tex tube as a conduit to support a French 18 catheter for gastrostomy and evaluated its safety, efficacy, and usefulness in decreasing postoperative complications.

**Methods:** Forty patients with CNS trauma, swallowing dysfunction or esophageal obstruction and in whom PEG had either failed or was not possible were enrolled. Patients were randomized into two equal groups of Gore-Tex assisted modified Stamm's gastrostomy (GAMSG) and the conventional Stamm gastrostomy (CSG). In the GAMSG group we initially secured a 6–10 cm length and 8 mm diameter tubular Gore-Tex to the gastric and abdominal wall as a conduit and then passed a French 18 catheter through it. Conventional Stamm procedure was applied to all patients in CSG group. Groups were compared for insertion times, pain, dislodgment, leakage rate, surrounding skin erythema and major complications. These patients were followed monthly for 6 months.

**Results:** The overall complication rate after GAMSG group was 5.3% (0% major) compared with 33.3% for Stamm gastrostomies (11.2% major) ( $p < 0.05$ ). Pain, operation site erythema, and tube leakage was significantly less in GAMSG group ( $p < 0.05$ ).

**Conclusions:** Applying a tubular Gore-Tex conduit as a support for a feeding tube in Stamm's method effectively lowers complication rates without significantly increasing operation time or expenses.

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### 1. Introduction

Gastrostomy is a procedure that involves providing access to the stomach through the abdominal wall. It is most commonly performed to provide nutritional support in patients who need long-term nutritional support and are not able to ingest food normally. It may also be performed to decompress the bowel. The preferred method for enteric access for the long-term nutrition of patients with swallowing disorders is percutaneous endoscopic gastrostomy (PEG).<sup>1–3</sup> This method was first successfully accomplished by Gauderer and Ponsky in 1979.<sup>4</sup> However, when PEG is either not possible or fails, percutaneous non-endoscopic radiographic gastrostomy or surgical gastrostomy (SG) are the two other alternatives.<sup>5</sup>

Surgical gastrostomy was initially conceived of by a Norwegian surgeon named Egeberg in 1837.<sup>5</sup> The first successful gastrostomy was performed in 1876 by Verneuib in Paris.<sup>5</sup> Subsequently, multiple techniques have developed. Among the open techniques, Stamm's technique is the most commonly and convenient method used.<sup>6</sup>

Using the Stamm's method of open gastrostomy a tube is surgically inserted and is used for feeding or decompression. The tube is retained in the stomach between the feeding intervals. Multiple complications have been reported with SG, i.e. infection, dislodgement, aspiration pneumonia, leakage about the gastrostomy tube, separation of the skin, excessive pain, wound infection, excessive granulation tissue about the gastrostomy site, pyloric obstruction by the gastrostomy tube, abscess formation, gastric erosion, gastric ulceration, and gastric perforation with intra-gastric and intraperitoneal bleeding.<sup>7,8</sup> A large number of these complications are mainly related to the tube that is left in the stomach. The purpose of this study was to investigate the safety and

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efficacy of utilizing a tubular Gore-Tex tube functioning as a gastrostomy conduit in decreasing postoperative complications of open gastrostomy.

## 2. Methods

This prospective clinical study started in March 2004 at our University hospital. All patients that were referred to our center for gastrostomy placement were initially triaged and if PEG could not be performed in them they were enrolled in our study. All of the patients were hemodynamically stable and were predicted to need enteric feeding for more than 14 days. These patients were then randomly allocated into two different groups. The first group received the Stamm's conventional procedure (CSG) and in the second group we performed our new technique of Gore-Tex assisted modified Stamm's gastrostomy (GAMSG).

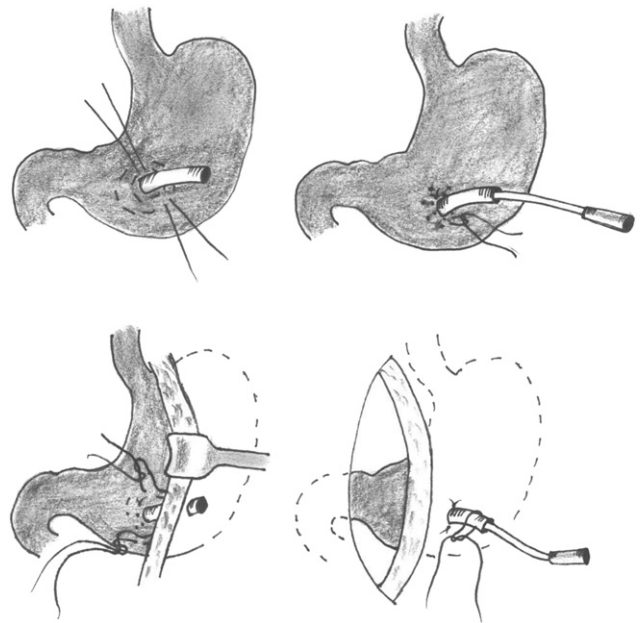
The study was approved by Shiraz University of Medical Sciences Ethical Committee. All patients or their power of attorney were consented for operation after explaining the procedure, its risks, benefits and possible postoperative complications. A total of 40 patients were found eligible for our study and were enrolled.

### 2.1. Exclusion criteria

Patients younger than 20 years and older than 65 years of age, patients with prior gastric surgery, patients with a prior history of upper abdominal surgery or moribund patient with advanced cancer, obstruction of the upper aerodigestive tract, patients with inaccessible stomach due to high location, hepatomegaly or coverage by transverse colon.

### 2.2. Surgical technique

The patients were positioned in a supine position. The abdomen was swabbed with povidone iodine 10% and draped. Midazolam 0.1 mg/kg was infused intravenously in order to achieve sedation. None of our patients received general anesthesia. The site of operation in the upper midline abdomen was numbered using 15–20 ml of lidocaine 1%. All patients received a single intravenous dose of 1 g cephalexin as prophylaxis. In the first group, the MSG group, a mushroom catheter 24 French MIC gastrostomy tube (Medical Innovation Corporation, Milpitas, CA) was utilized as the conduit. The technique for gastrostomy was consistent and included the Stamm technique.<sup>2</sup> In the second group, the GAMSG group, an 8–10 cm upper midline abdominal incision was made and the stomach was grasped with two Babcock clamps. Two concentric purse string sutures (2-0 silk) were placed on the anterior gastric wall over the antrum, approximately 2 cm apart. An opening into the stomach was made with electrocautery in the center of the inner purse string suture. A tubular 8 mm Gore-Tex, approximately 6–10 cm long (depending on the thickness of abdominal wall) was inserted into the gastric opening (Fig. 1). The depth of inserted Gore-Tex into the stomach was 2 cm (Fig. 1-1). The Gore-Tex was secured to the gastric opening in four points, using a 3-0 prolene suture. Afterwards, an 18 French catheter tube was inserted through the Gore-Tex into the stomach (Fig. 1-2). Two inner and outer purse string sutures were tied. The purse sutures were tightened only as much as the free space around the 18 French tube and the Gore-Tex tube was eliminated. The Gore-Tex external end was then brought out of the abdominal wall through another 2 cm incision in the anterior abdominal wall (Fig. 1-3). The stomach was fixed to the abdominal wall by tacking sutures that traverse the seromuscular layer of the stomach and the peritoneum around the exit site of the catheter. One to two 3-0 nylon simple sutures were placed in the skin and fixed the outer site of Gore-Tex tube to the

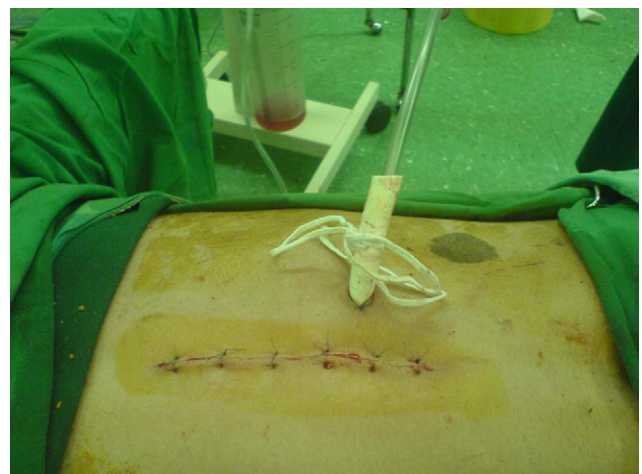


**Fig. 1.** Gore-Tex surgical technique. **Fig. 1-1:** Upper right, showing the Gore-Tex conduit being inserted into the stomach; **Fig. 1-2:** Upper left, demonstrating insertion of 18 French catheter tube through the Gore-Tex conduit into the stomach; **Fig. 1-3:** Lower left, Gore-Tex external end is secured to the anterior abdominal wall; **Fig. 1-4:** Lower right, final stage of tightly securing the Gore-Tex conduit around the 18 French catheter.

skin. An umbilical tape is tied around the Gore-Tex tube and the 18 French catheter inside to provide more support and prevent leakage of gastric content from around the French tube (Fig. 1-4). This umbilical tape would later be used to close the Gore-Tex conduit and allow us to change the 18 French catheter when needed. The 18 French tube from the Gore-Tex tube was then fixed to the left upper abdominal wall as described in Stamm's procedure<sup>2</sup> (Fig. 2).

Feeding was started 24 h after the procedure. Patients were followed monthly for 6 months and were evaluated for post-operative complications, i.e. pain, erythema and skin infection, dislodging of the tube, leak, aspiration, peritonitis, re-surgery, and conversion to jejunostomy.

In GAMSG group, the French tube inserted through the Gore-Tex tube into the stomach was used for feeding and the umbilical tape



**Fig. 2.** External appearance of the Gore-Tex and French catheter.

around it provided more support in order to prevent leakage of the gastric content. When the feeding was completed the umbilical tape was loosened and the French tube removed. The external end of the Gore-Tex tube was then secured with the umbilical tape (Fig. 1-3). This way the tube was not left in the stomach when not needed.

### 2.3. Statistical methods

Statistical analysis was by Student's *t*-test, chi square analysis and sided-fisher exact test.

## 3. Results

From March 2004 through July 2006, 20 patients were enrolled in the study. Experience in these 20 patients was compared with 20 Stamm gastrostomies placed from April 2001 through December 2006. Demographic characteristic and indications for gastrostomy are compared in Table 1. All of the patients in the GAMSG were followed for 6 months.

The major indication for gastrostomy was altered mental status due to head trauma (65% in GAMSG and 70% in CSG). Gastrointestinal decompression and swallowing difficulty were among the second most common indication. One patient in GAMSG had mediastinitis due to dental abscess and one patient in either group had oropharyngeal squamous cell carcinoma.

The average operating room time required for Stamm gastrostomy was  $85 \pm 21$  min compared with that for our modified method of GAMSG of  $106 \pm 20$  min ( $p > 0.05$ ). There was no statistically significant difference between the times of operation in the two groups.

None of our patients needed general anesthesia. Enteral feeding was started at the same time in both groups.

Complications after Gore-Tex assisted modified gastrostomy occurred in 5.3% of the patients (Table 2). We had no major complication in this group. None of our patients experienced aspiration pneumonia. The only minor complication that was seen in one of our patients was extreme pain at the site of operation and required intermittent intravenous narcotic analgesics. None of our patients experienced significant cellulitis. Slight redness at the site of operation was observed in half of our patients however, it was not significant. The feeding tube was removed after feeding and therefore none of our patients experienced dislodging of the tube or gastric wall necrosis.

Complications after Stamm gastrostomies occurred in 33.3% of patients (Table 2). The incidence of complication was significantly higher than for GAMSG group ( $p < 0.005$ ). Four wound infections occurred requiring partial opening of the incision and daily dressing change. Gastric juice leakage occurred in four of our patients, one of them from the group that also had wound infection and that required wound debridement. None of our patients developed gastric wall necrosis.

**Table 1**  
Demographic characteristics of patients.

	CSG*	GAMSG**	<i>p</i> value
Number of patients	20	20	NS
Age $\pm$ SD	$30.6 \pm 8.2$	$28.6 \pm 6.1$	NS
Sex M/F	17/3	18/2	NS
Reason for gastrostomy			
Altered mental state	13	14	NS
Difficulty swallowing	2	3	NS
Head and neck Cancer	1	1	NS
GI decompression	3	2	NS
Others	1	0	NS

\*CSG = Stamm's conventional procedure.

\*\*GAMSG = Gore-Tex assisted modified Stamm's gastrostomy.

**Table 2**

Complications of Gore-Tex assisted modified Stamm gastrostomy (GAMSG) and conventional Stamm gastrostomy (CSG).

Complications	GAMSG	CSG	<i>p</i> value
Major complications			
Aspiration	0	0	NS
Conversion to jejunostomy	0	1 (5.6%)	NS
Peritonitis	0	1 (5.6%)	NS
Feeding intolerance	0	0	NS
Minor complications			
Pain	1 (5.3%)	5 (27.8%)	0.07
Erythema and infection	0	4 (22.2%)	0.04
Tube dislodging	0	1 (5.6%)	NS
Leak	0	2 (10.1%)	0.04
Total	1 (5.3%)	6 (33.3%)	<0.05

Ultimate outcome of all patients is shown in Table 3. In this study, no patient died as a complication of placement of the feeding gastrostomy. One patient in the GAMSG group and one in the CSG group did from primary carcinoma. One patient in the CSG did not return for complete 6 months follow up and therefore was removed from out data analysis.

## 4. Discussion

PEG or radiographic gastrostomies are the current gold standard of gastrostomy insertion.<sup>9</sup> When compared to open gastrostomy, they require less operation time, cost less and have lower complication rates.<sup>2</sup> However, these techniques are not always available and in some instances the patients are not safe candidates for these procedures. Conditions that preclude endoscopic placement of a gastrostomy are obstruction of the upper aerodigestive tract, prior upper abdominal surgery, or inaccessible stomach due to high location, hepatomegaly or coverage by transverse colon, ascites, extreme obesity, esophageal or gastric varices, and moribund patients.<sup>1</sup> In these patients open gastrostomy would be the treatment of choice.

A variety of complications have been reported with open gastrostomy. Some of the most common complications are dislodging, gastric juice leakage, skin erythema, gastric wall necrosis and excruciating pain.<sup>3,5,6,8</sup> Through the years different methods have been suggested in order to reduce complications. Witzel channeled the catheter in the stomach wall to prevent the risk of leakage of gastrointestinal contents.<sup>10</sup> The denomination 'Witzel fistula' later became synonymous with gastrostomy. Stamm fixed the catheter to the abdominal wall and gastric wall by several purse string sutures, the Stamm procedure.<sup>2</sup> In our patients, we initially placed a 6–10 cm length and 8 mm diameter tubular Gore-Tex in the gastrostomy orifice and tightly secured it to the gastric wall and the abdominal wall. A French 18 catheter, used for enteric feeding, was then inserted into this conduit and after enteric feeding was finished the tube was removed and the conduit was tightly closed until the next episode of enteric feeding. By this method we eliminated the need to secure a long French tube, currently being utilized in most methods of open gastrostomy. The French catheter was removed after feeding, eliminating the risk of getting dislodged

**Table 3**  
Ultimate outcomes of the patients.

	GAMSG	CSG
Tube removed, oral diet	0	2
Died	1	1
Lost in follow-up	0	1
Tube OK, continued follow up	19	18

and therefore the need for re-operation. In our study, 5.6% of the patients in the Stamm gastrostomy group developed tube dislodgment. This is similar to other studies that utilized Stamm's method.<sup>5,6,11</sup>

In our patients we used tubular Gore-Tex. The reason for specifically using Gore-Tex was prior studies on Gore-Tex, proving its high capability of performing as a secure conduit. It has been reported that Gore-Tex is a highly desirable material for permanent gastrostomy tube.<sup>7,12</sup> The silicone rubber tubing is soft, pliable, and inert, and it maintains these unique characteristics during prolonged implantation in the human body. Additionally, it causes minimal irritation or erosion of the stomach's mucosa. The most important characteristic of Gore-Tex is that it causes minimal formation of granulation tissue around it and therefore decreases leakage and improves tube tract hygiene.<sup>12</sup> It has been previously proven, both in animal and in human studies, that the Gore-Tex flange and cuff are conductive to the in growth of both connective tissue and epithelium, thus fixing the flange and cuff securely to the tissue and sealing the tube tract. This prevents the leakage of gastric secretion and contents from around the tube. Our method significantly decreased this particular risk of leakage. Cosentini et al. compared the outcomes and complications in patients having undergone gastrostomy by surgical, percutaneous endoscopic, or percutaneous radiological procedure.<sup>13</sup> One patient (7%) out of 14 patients in the open gastrostomy tube developed leak. In our study, 10.1% of patients in the CSG group developed gastric juice leakage, which is very similar to prior studies.<sup>2,13</sup> This rate significantly decreased (0%) when we applied the Gore-Tex tube. Lower incidence of leakage was almost always associated with less skin irritation and lower rate of infection. Kadakia et al. utilized Foley catheter and reported a decrease rate in leakage and conclusively lower rate of skin irritation and wound infection.<sup>14</sup>

In the current study, the main advantage of using Gore-Tex conduit was providing us the capability to remove the feeding tube. By removing the feeding tube we were able to eliminate multiple potential complications. One of these complications was gastric wall necrosis. Risk of gastric wall necrosis exists in all patients receiving gastrostomy, regardless of the method utilized.<sup>8</sup> Connor et al. reported pyloric obstruction by gastrostomy tube, erosion of gastrostomy tube through the stomach and diaphragm in 5.5% of their patients.<sup>8</sup> This complication is mainly caused secondary to the pressure that the mushroom head of the distal end of the tube (that is made to secure the tube inside the stomach and to prevent it from getting dislodged) applies on the gastric wall.<sup>8</sup> By removing the feeding tube the risk of gastric necrosis due to long-term pressure effect caused by the tube on the gastric wall was eliminated.

The average operating room time required for our method was approximately 15–20 min longer when compared to the Stamm gastrostomy group. However, this difference was not statistically significant ( $p > 0.05$ ).

In our study, only one patient in the GAMSG group complained of excruciating pain. Pain was significantly less, when compared to the CSG group. We implicated that the main reason for pain in

patients with Stamm gastrostomy was the pressure effect of the mushroom catheter on the sutures and site of incision. We presumed that removable of the catheter in GAMSG group eliminated the pressure over gastrostomy site and made it more painless and tolerable.

In conclusion, utilizing tubular Gore-Tex as a conduit appears to lower the complications of open gastrostomy. Therefore, in conditions when endoscopic gastrostomy is impossible, Gore-Tex application to Stamm's method can significantly decrease postoperative complications without significantly increasing the time of operation or expense.

#### Conflict of interest

None declared.

#### Funding

None declared.

#### Ethical approval

The study was approved by Shiraz University of Medical Sciences Ethical Committee.

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