

Clinical Study of only One Stage Esophagoplasty by using Jejunum with Esophageal Stricture

Hwan Su Liu, Hyon Jong Kim*, Mun Sob Won, Myong Nam Ri, Yong Jin Liu

ABSTRACT

Background: Esophagoplasty is very important in the patients who couldn't eat normal cereal since they had organic and functional diseases in esophagus. Esophagoplasty is including multi-stage plasty and one-stage one, but most surgeon in thoracic field was concerned that one-stage plasty was reduced the duration of hospitalization, mental and physical burden, especially complications and sequelae after operations. **Method:** Between January 1999 and December 2015, 432 consecutive cases of cicatricial esophageal stricture were enrolled in the study at Pyongyang medical college hospital, Kim Il Sung University. The patients were randomly selected to undergo one-stage esophagoplasty (study group, 71 cases) or step-by-step esophagoplasty (control group, 361 cases). **Result:** One stage esophagoplasty with jejunum is associated with good postoperative result (effectiveness shortly after operation $97.2 \pm 2.7\%$, follow up effectiveness $98.4 \pm 2.6\%$) and more simplified operating method, so it is possible to introduce into the clinical practice of esophagus surgery. **Conclusion:** One stage esophagoplasty with jejunum is more simplified and needs less operation time compared with step by step esophagoplasty. It is also related with good postoperative result and less complication, which allows the wide introduction into the clinical practice of esophagus surgery.

Key words: Esophagoplasty, Cicatricial esophageal stricture, One-stage esophagoplasty, Esophago-pasty with jejunum.

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INTRODUCTION

One stage esophagoplasty is an operation aimed to reduce mental and physical burden of the patients, to shorten the periods of disability, and to improve the quality of life. Esophagoplasty is imperative for the patients who are unable to have normal meals with organic and functional diseases of the esophagus.

Esophagoplasty, dating from the latter half of the 19th century, has been studied for a long time. Its development has been further promoted since the early 1940's by striking development of modern surgery, rapid progress of anesthesiology, as well as the emergence of potent anti-shock measures and antibiotics.

Esophagoplastic techniques up to date can be classified into total esophagectomy, subtotal esophagectomy, partial esophagectomy, segmental esophagoplasty, and local esophagoplasty according to the reconstructive range of structured esophagus.^[3]

However, due to its extensiveness and complexity, it entails long operating time, large operation-associated injury, big mental burden for the patient, and different postoperative complications and sequels, and therefore, it remains to be difficult and complicated surgery.^[5]

In consideration of such situation, we have conducted the research work with the following purposes.

1. To modify the present technique of step-by-step esophagoplasty and to establish rational one stage esophagoplasty.
2. To determine the surgical properties and advantages of the new technique.
3. To improve the postoperative results and provide the scientific and technical basis for the introduction of new technique into the clinical practice.

PATIENTS AND METHODS

Patients

432 consecutive cases (esophageal tumor, cicatricial esophageal stricture, esophageal injury etc) of esophageal stricture were enrolled in the study. The patients were randomly selected to undergo one-stage esophagoplasty (study group, 71 cases) or step-by-step esophagoplasty (control group, 361 cases) according to operation indication.

Operation indication and contraindication is as following:

Indication of operation (established by Association of Thoracic and Cardiovascular surgery of DPRK 2009):

1. Range of age: 6~67yrs.

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2. Failed the palliative treatment and Bougie therapy with esophageal diseases.
3. Patient's condition change to weak, but his/her weight must be more than 90% of standard one.
4. Be disturbed Barium passing through the esophagus in X-ray.
5. Major organ function must be normal (i.e. heart, lung, kidney, liver).

Contraindication of operation (Established by Association of Thoracic and Cardiovascular surgery of DPRK 2009):

1. Patient's age: younger than 6 yrs.
2. Be suspected the metastasis of esophageal cancer.
3. Patient had any complications such as T.B of the lung, disease of heart valves, acute hepatitis etc.
4. Following stations: the period of female menstruation and pregnancy.

Sex and age-related composition

In the study group men and women were 41 cases (57.7%) and 30 cases (42.3%) respectively, while in the control group they were 214 cases (59.3%) and 147 cases (40.7%) respectively, with men to women ratio of 1.4:1.

In both group, the age peak was in the subgroup between 26 and 29 [study group, 36 cases (50.7%); control group, 143 cases (39.6%)] and the average age was 27.8 in the study group, and 26.5 in the control group (range: 6-61 in both group).

Composition by the level of stricture site

Pharynx stricture were 9 cases (12.7%) in the study group and 27 cases (7.5%) in the control group, while cervical stricture were 18 cases (25.3%) and 129 cases (35.7%), thoracic stricture 42 cases (59.2%) and 202 cases (56.0%), and abdominal stricture 2 cases (2.8%) and 3 cases (0.8%) respectively.

Composition by the degree of stricture

Complete stricture were 53 cases (74.6%) in the study group and 186 cases (51.5%), while incomplete stricture were 18 cases (25.4%) and 175 cases (48.5%) respectively.

Operative technique

One stage esophagoplasty with jejunum

One stage esophagoplasty with jejunum is done in 3 phases.

Phase 1 (mobilization of intestine)

The abdomen is medicated in the epigastric region and 2nd, 3rd, 4th branches of superior mesenteric artery and vein are ligated and cut. If the mobilized intestine is short, the first descending branches of superior mesenteric artery and vein are ligated and sympathetic ganglion around the main trophic branch is resected.

Then, presternal, retrosternal, or intrathoracic channel is made, and the mobilized intestine is pulled up to the level of esophageal constriction.

Phase 2(esophagus-intestine anastomosis)

Pharyngoesophageal-intestinal anastomosis:

In case of high-level lemostenosis, the external rim of left thyroid cartilage is resected 1cm in width, and the greater horn of hyoid bone is pushed aside to the right to expose the pharyngoesophagus.

The stenotic site is found, incised horizontally 1.5~2cm in width, and stump to stump anastomosis or stump to side anastomosis is done with the mobilized intestine.

Cervicoesophageal-intestinal anastomosis:

The cervical esophagus is incised horizontally as wide as the anterior wall of esophagus. The mobilized intestine is also incised horizontally as wide as the length of the esophageal incision (the incision is done 1cm inferior to the stump), and esophagus and intestine is anastomosed.

What is somewhat different from the previous technique is that the esophagus and the mobilized intestine are incised horizontally so that the actual length of mobilized intestine can be lengthened 2~2.5cms further.

If stricture is more than 2cms above the sternal notch, necessary measure is taken for the caecus.

Intrathoracic esophageal-intestinal anastomosis:

The thorax is opened with anterolateral incision along the 4th, 5th, or 6th intercostal space according to the level of esophageal constriction. The pleura is incised 6~8cms in the *sternocostal* triangle region beneath the xiphoid process and intrathoracic channel is made that links the abdominal cavity and right pleural cavity.

Phase 3 (Gastrointestinal anastomosis)

Stump to side gastrointestinal anastomosis:

Jejunum is cut at the starting part of mobilized intestine. The proximal stump is anastomosed to the anterior wall of the gastric body by stump to side anastomosis. To maintain good passing of food, we chose to make anastomosis in physiological position. If the gastric fistula lies near the pylorus, anastomosis is made above the fistula, and if it lies near the cardia, anastomosis is made at the anterior wall 1.5~2cms below the fistula. (It took 2~3 weeks for most of all patients' gastric fistula to heal after had remove fistula tube. 83.8% of fistula naturally closed, but 16.2% were performed operation.)

The distal stump is anastomosed to the proximal end of the initial part of jejunum, thereby removing the extra jejunal loop of 30~50cms and providing the physiological continuity of the digestive tract.

Side to side gastrointestinal anastomosis:

The proximal end of jejunum that was cut mobilizing the jejunum is anastomosed in Y shape at the initial part of the mobilized intestine and side to side gastrointestinal anastomosis was done.

When side to side gastrointestinal anastomosis is complete, deferent angle of mobilized intestine is bended and brought close to the afferent intestinal wall and fixed about 5cms by seromuscular suture so that the food that comes down along the artificial esophagus does not come down to the deferent angle but enter the stomach.

Stage by stage esophagoplasty (control)

Stage by stage esophagoplasty (control) is done by previous surgical technique in several stages that makes use of stomach, colon, and jejunum.

RESULTS

Properties of one stage esophagoplasty Channels of esophagoplasty with jejunum

We had mainly performed stage by stage esophagoplasty before 2010, chosen one stage esophagoplasty after 2011.

Treatment duration was defined as a span from the beginning of esophagoplasty to the endpoint of last operation. Dead cases were precluded from the Table 1.

Average duration of treatment

As is shown in Table 2 the average duration of treatment was 1.4±0.01days in the study group, and 270.6±5.16days in the control group.

Average time for operation

The average time needed for operation was 220 ± 2.86 min in the study group and 443.5 ± 5.81 min in the control group, being shortened more than 2 times in the former group. The average time was being significantly longer in the control group, it related to operation skills in beginning stage of treatment Table 3.

Intraoperative evaluation of the severity of patients

Intraoperative evaluation of the severity of patients showed no significant difference between the two groups.

Result of one stage esophagoplasty

Result of intestine mobilization

Anesthesia method of esophagoplasty

As is shown in Table 4, Intestine mobilization was done under endotracheal general anesthesia for all cases in both group. For control group, esophagus-intestine anastomosis and gastrointestinal anastomosis was done under endotracheal or local anesthesia, because their invasion range are minor. And all procedures performed in our studies involving patients were in accordance with the ethical standards of the national medical committee of DPRK under patient's agreement.

Incidence of complication of intestine mobilization

Incidence of complication for intestine mobilization was 10.0% (7 cases) in the study group and 13.9% (49 cases), the latter being significantly higher Table 5.

Result of esophagus-intestine anastomosis

Anastomosis insufficiency rate by direction of incision of esophagus and mobilized intestine

As is shown in Table 6, anastomosis insufficiency was found in 1 case (1.4%) of study group for horizontal incision, and for the oblique and vertical incision it was noted in 330 cases (66.5%).

Stenosing rate after esophagus-mobilized intestine anastomosis

As shown in the Table 7, steno sing rate after the occurrence of anastomotic insufficiency was 80.0% (184 cases) in the control group, while steno sing rate without insufficiency was 1.4% (1 case) in the study group and 4.8% (6 cases) in the control group.

Result of gastrointestinal anastomosis

Composition by methods of gastrointestinal anastomosis

As is shown in Table 8, in the study group, gastric fistula was not surgically closed in all cases and natural closure occurred in 57 cases (81.4%), but in the control group, gastric fistula was surgically closed in all cases.

Incidence of complication after gastrointestinal anastomosis

All cases of anastomotic stricture, peritonitis, and passage disturbance of artificial esophagus were treated with reoperation and anastomotic ulcer cases with conservative treatment Table 9.

Postoperative function of artificial esophagus

Passage rate of artificial esophagus by types of food

As is shown in Table 10, follow-up effectiveness was 96.9% (63 cases) in the study group and 71.0% (242 cases) in the control group.

Barium passing time through artificial esophagus

As is shown in Table 11, after intaking barium sulfate, the average time passing through artificial esophagus were 16.7 ± 1.20 s in the study group and 20.1 ± 1.20 s in the control group, the former being significantly shorter.

Postoperative result of one stage esophagoplasty

As is shown in Table 12, postoperative effectiveness in the follow up period was 98.4% (64 cases) in the study group and 49.3% (168 cases), the former being significantly higher.

DISCUSSION

Artificial esophagoplasty with jejunum, since its first introduction in 3 stage anastomoses in 1907, has continued its development and is still developing day by day.^[1]

Nowadays, together with the development of modern esophagus surgery, there is a growing tendency that surgeons switch from stage by stage esophagoplasty over to the one stage esophagoplasty.

There are several published reports about one stage artificial esophagoplasty with entire stomach, but that with small intestine or large intestine is extremely rare. There are even some reports that insist the impossibility of esophagoplasty with small intestine due to the structural characteristics of *mesenterium*, and in other reports, they recommend not to try esophagoplasty with large intestine because of many intraperitoneal anastomoses, long operation time, and great intraoperative injury.^[3,4]

In case entire stomach is used in one stage esophagoplasty, it is considered as good plastic material with no anastomotic sites and abundant blood circulation.^[2,8]

The properties and superiorities of newly invented one stage esophagoplasty are as follows.

1. In the first phase of mobilization of intestine, descending rami of the first branch of superior mesenteric artery and sympathetic nerve around the trophic vessel are cut to lengthen the mobilized intestine and stump to stump anastomosis of jejunum is used instead of Y shaped anastomosis, thereby removing the residual jejunal loop of 30~50cm and providing the continuity of digestive tract.^[6]
2. In the sec phase of esophagus-mobilized intestine anastomosis, in case of high-level lemostenosis, left thyroid cartilage is resected 1cm in width and pharyngoesophagus and mobilized intestine are anastomosed, esophagus and mobilized intestine are incised horizontally at the anastomosis site, and caecus is cut.^[4,7]
3. In the third phase of gastrointestinal anastomosis, anastomosis site is selected to the more physiological position, gastric fistula is preserved so that postoperative endogastric pressure is lowered and incidence of complication is decreased, methods of jejunal stump to stump anastomosis and bending fixation of deferent angle are designed newly to shorten the treatment period, decrease the incidence of complication, and to improve the function of artificial esophagus.^[3,6]
4. In our experiences, operation approach is more simplified than other artificial materials, needs less operation time^[8] and minor intraoperative injury, maintains good artificial esophageal function. Besides, it will be tried to the patients with old ages and worse common condition, because operation risk is very lower and death rate is smaller than 1%. It is also related with good postoperative result and less complication, which allows the wide introduction into the clinical practice of esophagus surgery.

Table 1: Number of patients by channels of esophagoplasty.

	Channel of esophagoplasty		
	Presternal	Retrosternal	Intrathoracic
Study group(n=71)	2 (2.8)	58 (81.7)	11 (15.5)
Control group(n=354)	19 (5.4)	331 (93.5)	4 (1.1)

(): %

Table 2: Treatment duration by groups.

	Duration(days)					Average duration of treatment (X±SD) (days)
	~2	~365 (1yr)	~730 (2yrs)	~1095 (3yrs)	1460 (4yrs)~	
Study group (n=70)	69 (98.6)	1(1.4)	-	-	-	1.4±0.01
Control group (n=354)	-	286 (80.8)	30 (3.5)	17 (4.8)	21 (5.9)	270.6±5.16

(): %

Table 3: Average time for operation (min).

	Mobilization of intestine	Esophagus-intestine anastomosis	Gastrointestinal anastomosis	Total time for operation (X±SD)
Study group (n=70)	126.3±5.38	64.1±2.47	29.9±0.74	220.3±2.86
Control group (n=354)	161.2±6.59	135.5±4.63	146.8±6.21	443.5±5.81
P	<0.01	<0.01	<0.01	<0.01

Table 4: Anesthesia method of esophagoplasty.

	Study Group	Control group		
		Intestine mobilization	Esophagus-intestine anastomosis	Gastrointestinal anastomosis
Endotracheal intubation+Intravenous morphine	42 (59.2)	132 (36.5)	57 (16.1)	67 (15.9)
Endotracheal intubation+halothane inhalation	29 (40.8)	180 (49.9)	79 (22.3)	116 (32.8)
Endotracheal intubation+Ether inhalation	-	49 (13.6)	-	-
Local anesthesia	-	-	218 (61.6)	171 (48.3)
Total	71 (100.0)	361 (100.0)	354 (100.0)	354 (100.0)

(): %

Table 5: Incidence of complication of intestine mobilization.

	Necrosis of mobilized intestine	Pneumothorax		Passage disturbance of mobilized intestine	Dumping of mobilized intestine	Total
		unilateral	bilateral			
Study group (n=70)	2(2.9)	5(7.1)	-	-	-	7(10.0)
Control group (n=354)	7(2.0)	35(9.9)	3(0.8)	2(0.6)	2(0.6)	49(13.9)

(): %

Table 6: Anastomosis insufficiency rate by direction of incision of esophagus and mobilized intestine.

	Horizontal incision		Oblique incision		Vertical incision	
	Number of cases	Insufficiency rate	Number of cases	Insufficiency rate	Number of cases	Insufficiency rate
Study group (n=70)	70 (100.0)	1(1.4)	-	-	-	-
Control group (n=354)	24 (100.0)	-	253 (100.0)	169 (66.8)	77 (100.0)	51 (66.2)

():%

Table 7: Stenosing rate of anastomosis region.

	Stenosing rate after anastomotic insufficiency		Stenosing rate without anastomotic insufficiency	
	Cases with insufficiency	Stenosing rate	Cases without insufficiency	Stenosing rate
Study group (n=70)	1(1.4)	-	69(98.6)	1(1.4)
Control group (n=354)	230(65.0)	184(80.0)	124(35.0)	6(4.8)

(): %

Table 8: Composition by methods of gastrointestinal anastomosis.

	Stump to side gastrointestinal anastomosis+ Stump to stump jejunal anastomosis	Side to side gastrointestinal anastomosis+ Jejunal bending fixation	Natural closure of gastric fistula
Study group (n=70)	14(20.0)	56(80.0)	57(81.4)
Control group (n=354)	-	12(3.4)	-

(): %

Table 9: Incidence of complication after gastrointestinal anastomosis.

	Anastomotic stricture	Peritonitis	Passage disturbance of artificial esophagus	Anastomotic ulcer
Study group (n=70)	1(1.4)	1(1.4)	-	-
Control group (n=354)	5(1.4)	5(1.4)	8(2.3)	3(0.8)

(): %

Table 10: Passage rate of artificial esophagus by types of food.

	Stage	Type of food			
		Boiled rice	Gruel	Rice water	Passing disturbance
Study group	Shortly after operation (n=70)	69(98.5)	-	1(1.4)	
	Follow up (n=65)	63(97.0)	1(1.5)	-	1(1.5)
Control group	Shortly after operation (n=354)	46(13.0)	86(24.3)	80(22.6)	142(40.8)
	Follow up (n=341)	54(15.8)	91(26.7)	85(24.9)	111(32.6)

(): %

Table 11: Barium passing time through artificial esophagus(s).

	~10	11~20	21~30	31~40	41~50	51~60	61~	Average time (X±SDs)	P
Study group (n=62)	8(12.0)	31(50.0)	9(14.5)	9(14.5)	4(6.5)	-	1(1.6)	16.7±1.20	<0.05
Control group (n=168)	9(5.4)	22(13.1)	61(36.3)	27(16.1)	22(13.1)	16(9.5)	11(6.5)	20.1±1.20	

Table 12: Postoperative result of one stage esophagoplasty.

Group	Stage	Significantly improved	Improved	No change	Worsened	Death	Effectiveness %±m	P
Shortly after op	Study Group (n=71)	67(94.4)	2(2.8)	1(1.4)	-	1(1.4)	97.2±2.7	<0.01
	Control group (n=361)	83(23.0)	66(18.3)	117(32.4)	89(24.6)	6(1.7)	41.3±2.6	
Follow up	Study Group (n=65)	63(96.7)	1(1.5)	1(1.5)	-	-	98.4±2.6	<0.01
	Control group (n=341)	97(28.4)	71(20.8)	91(26.7)	81(23.8)	1(0.3)	49.3±2.7	

(): %

CONCLUSION

We have improved the technique of the previous step by step artificial esophagoplasty and newly established more rational one stage esophagoplasty with jejunum. We have revealed the surgical properties and superiorities of newly invented one stage esophagoplasty.

One stage esophagoplasty with jejunum is associated with good postoperative result (effectiveness shortly after operation 97.2±2.7%, follow up effectiveness 98.4±2.6%) and more simplified operating method, so it is possible to introduce into the clinical practice of esophagus surgery.

Compliance with Ethical Standards:

Before saying Ethical Standards, we will describe about our country. Our country is a socialist society, the patient can receive free charge of treatment, and the studies for medical sciences are also supplied from our government. So, we don't feel any needs of fund and any **Conflicts of interest:**

In addition, all authors including in this study have no conflicts of interest.

Ethical approval

All procedures performed in our studies involving patients were in accordance with the ethical standards of the national medical committee of DPRK.

Informed consent

We obtained informed consents from all patients in accordance with national medical rules of DPRK.

ACKNOWLEDGMENT

We highly appreciated Prof. Liu HS's service, he was passed away 23, Nov, 2017.

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ABBREVIATION USED

We didn't use any abbreviation in this manuscript.

SUMMARY

Due to its extensiveness and complexity, it entails long operating time, large operation-associated injury, big mental burden for the patient, and different postoperative complications and sequels, and therefore, it remains to be difficult and complicated surgery.[5] There are several published reports about one stage artificial esophagoplasty with entire stomach, but that with small intestine or large intestine is extremely rare. There are even some reports that insist the impossibility of esophagoplasty with small intestine due to the structural characteristics of mesenterium, and in other reports, they recommend not to try esophagoplasty with large intestine because of many intraperitoneal anastomoses, long operation time, and great intraoperative injury.[2,8] We have improved the technique of the previous step by step artificial esophagoplasty and newly established more rational one stage esophagoplasty with jejunum. We have revealed the surgical properties and superiorities of newly invented one stage esophagoplasty.

REFERENCES

- Schraufnagel DE, *et al.* CT of the normal esophagus to define the normal air column and its extent and distribution. *AJR Am J Roentgenol.* 2008;191(3):748-52.
- Mark B, *et al.* "The esophagus" Textbook of surgery. 1992;301.
- Thomas W. *et al.* "General thoracic surgery": 1989;1012.
- Lorentz T. Anastomotic leakage after resection and bypass for esophageal cancer: lessons learned from world. *J surg.* 1989;13(4):472-7.
- Basam A. Surgical management of severe peptic esophageal stricture in children. *Hepatogastroenterology.* 2003;50(51):714-7.
- Oezcelik A, *et al.* "Thoracic surgery clinics". General Anatomy of the Esophagus. 2011;21(2):289-97.
- Dua KS. New approach to malignant strictures of the esophagus. *Curr Gastroenterol Rep.* 2003;5(3):198-205.
- Wang B. *et al.* Substituting esophagus with colon in the treatment of hypopharyngeal and esophageal disease. *Lin-Chuang-Er-Bi-Yan-Hou-Ke-Za-Zhi.* 2001;15(9): 389-90.