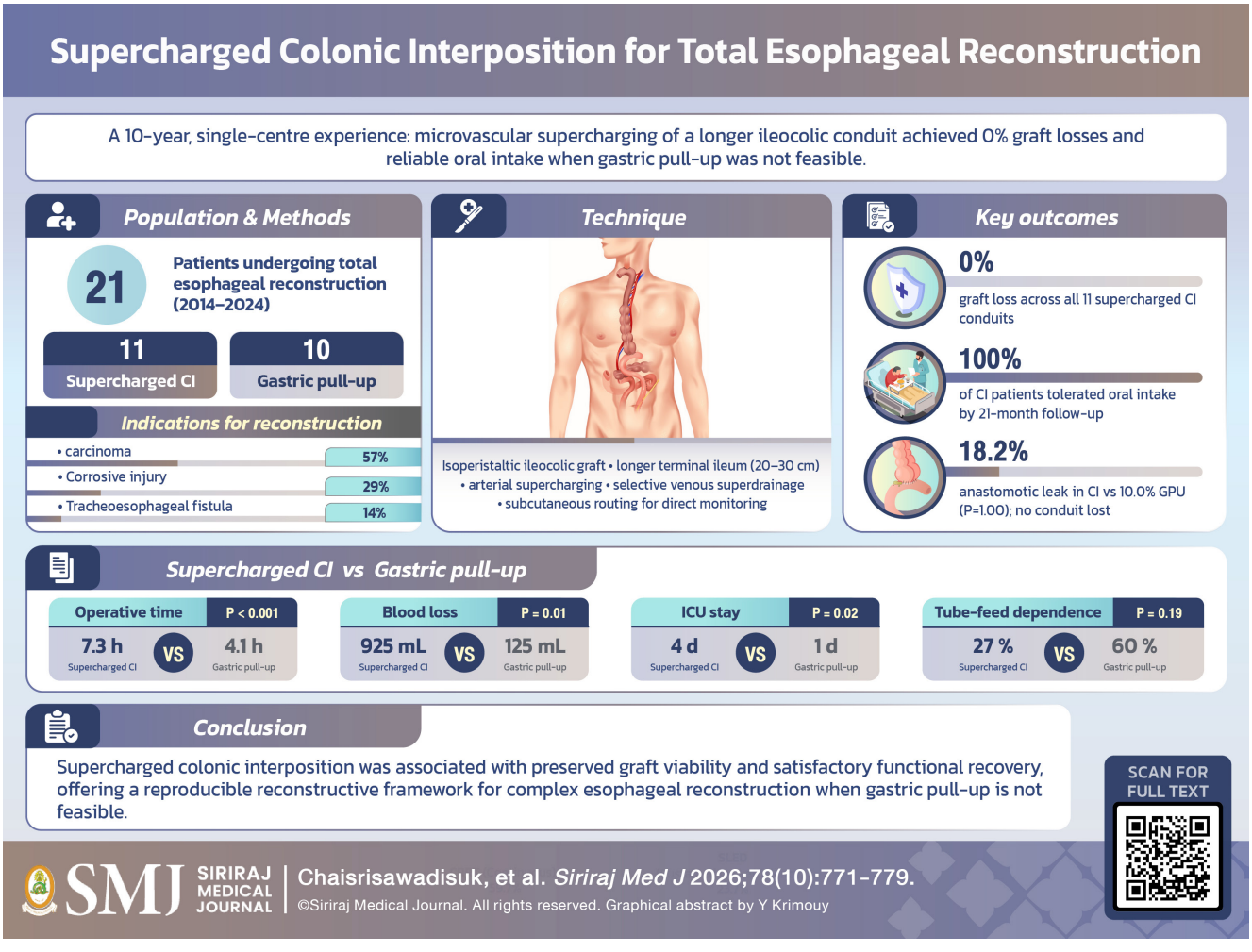
Supercharged Colonic Interposition for Total Oesophageal Reconstruction: Technical Refinements, Perioperative Protocol, and Functional Outcomes

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ABSTRACT

Objective: We report a 10-year experience with supercharged colonic interposition (CI) for total oesophageal reconstruction, focusing on technical refinements and functional outcomes.

Materials and Methods: A retrospective review of patients undergoing total oesophageal reconstruction (2014–2024) was conducted. A modified, supercharged CI was performed using a longer terminal ileal segment of 20–30 cm. Conduits were routed subcutaneously, and arterial supercharging—usually to the transverse cervical artery—was performed selectively. When congestion persisted, venous superdrainage was additionally implemented. Outcomes were compared with a contemporaneous gastric pull-up (GPU) cohort.

Results: Twenty-one patients underwent reconstruction (11 CI, 10 GPU). No graft failures occurred after supercharged CI. Anastomotic leakage occurred in 18.2% of CI and 10.0% of GPU patients (P=1.00) and was managed without conduit loss. Stricture was more frequent after CI (36.4% vs. 10.0%, P=0.31) and was successfully treated endoscopically. At a median follow-up of 21 months, all CI patients tolerated oral intake (45.5% solid, 45.5% soft diet); feeding tube dependence was 27.3% after CI vs. 60.0% after GPU (P=0.19).

Conclusions: Supercharged colonic interposition was associated with preserved graft viability and satisfactory functional recovery in patients requiring complex total oesophageal reconstruction. A defined selection algorithm, standardised technique, subcutaneous routing, and structured perioperative care offer a reproducible framework for complex oesophageal reconstruction when gastric pull-up is not feasible.

Keywords: Oesophageal reconstruction; colonic interposition; supercharged flap; microvascular augmentation; visceral reconstruction; swallowing function (Siriraj Med J 2026;78(10):771-779)

INTRODUCTION

Oesophageal reconstruction is among the most technically demanding procedures in reconstructive surgery. Loss of oesophageal continuity from malignancy, corrosive injury, stricture, or tracheoesophageal fistula severely impairs swallowing, nutrition, and quality of life.[1] Gastric pull-up (GPU) is the preferred conduit when feasible, owing to its dependable vascular supply and technical simplicity,[2,3] but prior gastrectomy, compromised gastric vascularity, or long-segment defects often preclude its use. Colonic interposition (CI) is the principal alternative, offering adequate length, orthodromic peristalsis, and reservoir capacity,[4,5] but its marginal vascular supply-particularly at the proximal graft segment-has historically predisposed to anastomotic leakage and graft compromise.[6,7]

Microvascular supercharging augments arterial inflow, and when needed, venous outflow, to reinforce the conduit at its most vulnerable segment. Published series[8-11] demonstrate improved graft viability with augmentation, but few define the clinical criteria that should trigger it, and technical algorithms for patient selection, conduit routing, and monitoring remain inconsistent.

We report a 10-year single-centre experience with supercharged CI for total oesophageal reconstruction, focusing on technical refinements that extend safe conduit reach, our rationale for a monitoring-oriented subcutaneous routing strategy, and a structured perioperative protocol. Functional outcomes, including a descriptive comparison with a contemporaneous GPU cohort, support this technical framework, which we intend as a reproducible model for centres managing complex oesophageal reconstruction when GPU is not feasible.

MATERIALS AND METHODS

Study design and setting

We retrospectively reviewed patients undergoing total oesophageal reconstruction at the Faculty of Medicine Siriraj Hospital from January 2014 to December 2024, using a prospectively maintained institutional database. This study was approved by the Siriraj Institutional Review Board (Si 048/2025).

Patient selection

Patients undergoing total oesophageal reconstruction for oesophageal carcinoma, corrosive injury, benign stricture, or tracheoesophageal fistula were included; those undergoing partial reconstruction or with incomplete records were excluded. Demographic, operative, and hospitalisation variables were collected, including age, sex, body mass index, smoking and alcohol history, prior gastric surgery, and preoperative chemoradiation. Postoperative outcomes included surgical and medical complications, dietary tolerance, feeding tube dependence, time to oral intake and to a regular diet, and survival status.

Conduit selection algorithm

GPU was used when the stomach was viable with adequate vascular supply; CI was chosen for patients with prior gastrectomy, compromised gastric vascularity, long-segment defects, or when gastric reconstruction was otherwise not feasible. Colon lumen and vascular arcades were routinely evaluated preoperatively to confirm conduit suitability.

Operative technique: modified supercharged CI

All conduits were isoperistaltic ileocolic grafts based on the terminal ileum and right colon, mobilised while preserving the middle colic vessels as the primary pedicle. A longer segment of terminal ileum (20-30 cm proximal to the ileocecal valve), rather than further transverse colon mobilisation, provided sufficient length while avoiding tension on the transverse mesentery and yielded a narrower-calibre segment for the cervical anastomosis. Arterial perfusion was assessed by direct visualisation and transillumination, supplemented by indocyanine green angiography in selected cases. Arterial supercharging-typically between terminal ileal branches and the transverse cervical artery-was performed under microscope before the proximal oesophageal anastomosis. (Fig 1) Venous superdrainage was added only when venous congestion of the conduit tip developed after arterial supercharging; when needed, the external jugular vein or a tributary was used. The proximal ileal segment was hand-sewn to the cervical oesophageal stump, in selected cases just distal to the pyriform sinus. Distally, the conduit was anastomosed to the gastric remnant or a Roux-en-Y jejunal limb, and a feeding jejunostomy was routinely placed.

Route selection: rationale for the subcutaneous pathway

All conduits were routed subcutaneously rather than through the posterior mediastinum, retrosternal space, or chest. Because a supercharged conduit's viability depends on a single microvascular anastomosis, we prioritised a route allowing continuous visual and Doppler surveillance and prompt salvage-an advantage the posterior mediastinal route, which conceals the conduit, cannot offer. This route also avoided dissection through a mediastinum or pleural space scarred by prior treatment and improved access for the cervical microvascular anastomosis. We accept that this route requires a longer conduit and has been linked to delayed emptying.[12]

Postoperative management

Patients received 7 days of antibiotic prophylaxis, proton pump inhibitors when a cologastric anastomosis was present, and routine prokinetic agents. The conduit was monitored via an externalised segment or Doppler ultrasound every 2 hours for the first 24 hr. Endoscopy was performed meticulously on postoperative day 1 to assess patency of the oesophageal anastomosis and viability of the ileo-colic graft. Oral intake was withheld 7-10 days pending a contrast esophagogram to exclude leakage, then advanced from liquids to a post-gastrectomy diet as tolerated. Vitamin D levels (deficiency if < 30 ng/ml) were checked after surgery throughout the postoperative period.

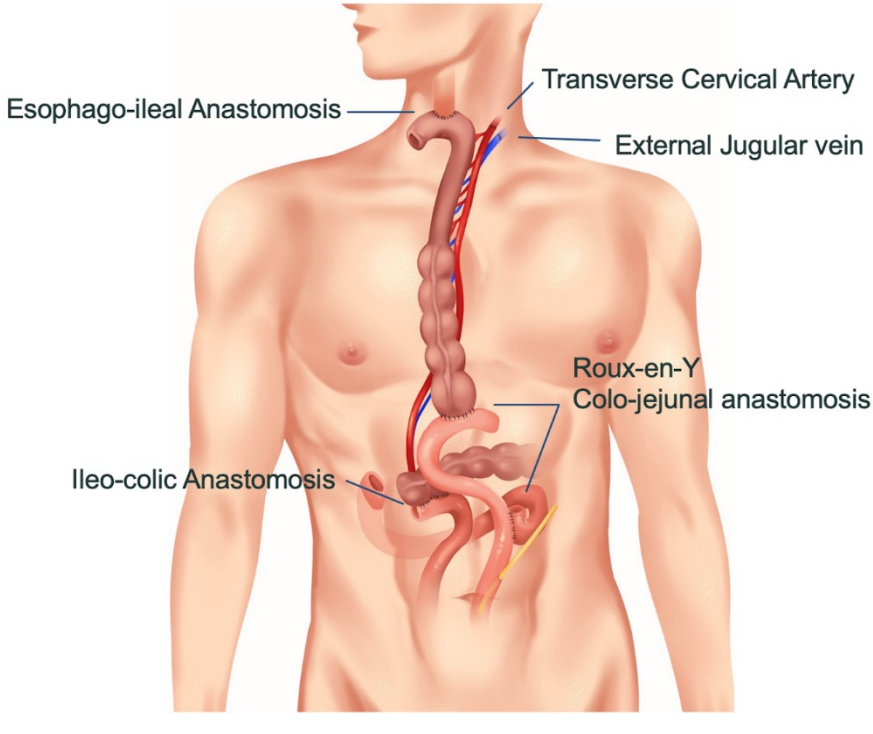


Fig 1. Surgical technique of supercharged colonic interposition. A longer segment of terminal ileum is used for cervical oesophageal reconstruction. The transverse cervical artery is anastomosed to the terminal ileal artery; if conduit congestion is observed, the external jugular vein is additionally anastomosed to the terminal ileal vein.

Statistical analysis

Continuous variables are reported as mean (SD) or median (range), and categorical variables as frequencies, with between-group comparisons by t test, Mann-Whitney U test, or Fisher exact test as appropriate (P<0.05 considered significant). Given the small, non-randomized samples and the absence of a power calculation, comparisons with GPU are exploratory rather than confirmatory.

RESULTS

Patient characteristics

Between 2014 and 2024, 21 patients underwent total oesophageal reconstruction: 11 (52.4%) with supercharged CI and 10 (47.6%) with GPU (Table 1). Mean age was 53.1 (SD 12.9) years, and 71.4% were male. Mean body mass index was 17.81 (SD 3.18) kg/m^2. Diagnoses included carcinoma (57.1%), corrosive injury (28.6%), and tracheoesophageal fistula (14.3%).

Operative outcomes

Table 2 demonstrates the outcomes after supercharged CI. The terminal ileal artery was the pedicle in all cases; the transverse cervical artery was the most common recipient artery (81.8%) and the external jugular vein the most common recipient vein (54.5%). Venous superdrainage was unnecessary in 2 patients (18.2%). All conduits were routed subcutaneously.

Median operative time (7.3 vs 4.1 hours, P<0.001), blood loss (925 vs 125 mL, P=0.01), and ICU stay (4 vs 1 day, P=0.02) were greater for CI than GPU; total hospitalisation did not differ significantly (24 vs 18.5 days, P=0.29) (Table 3).

No graft failures occurred in either group (Table 4). Anastomotic leakage occurred in 18.2% of CI and 10.0% of GPU patients and was managed without conduit loss. Stricture was the most frequent late CI complication (36.4% vs 10.0%) and was successfully treated endoscopically in all cases. Vitamin D deficiency was more common after CI (45.5% vs 10.0%). However, those showed no statistical difference.

Functional outcomes

At a median follow-up of 21 months, all CI patients tolerated oral intake, with 45.5% achieving a solid and

TABLE 1. Patient characteristics.

	All patients (*n* = 21)	Supercharged colonic interposition (*n* = 11)	Gastric pull-up (*n* = 10)	*P* value
Age, years; mean (SD)	53.1 (12.9)	51.1 (11.7)	55.4 (14.4)	0.45
BMI, kg/m^2; mean (SD)	17.81 (3.18)	18.40 (4.07)	17.17 (1.79)	0.39
Sex, *n* (%)				
Male	15 (71.4)	7 (63.6)	8 (80)	0.63
Female	6 (28.6)	4 (36.4)	2 (20)	
Preoperative chemoradiation, *n* (%)	4 (19%)	0 (0%)	4 (40%)	0.03
Diagnosis, *n* (%)				
Corrosive ingestion with esophageal stricture	6 (28.6)	5 (45)	1 (10)	0.11
Carcinoma	12 (57.1)	4 (36.4)	8 (80)	
Tracheoesophageal fistula	3 (14.3)	2 (18.2)	1 (10)	
Smoking status				
Former, *n* (%)	7 (33.3)	2 (18.2)	5 (50)	0.18
Alcohol status				
Former, n (%)	3 (14.3)	1 (9.1%)	2 (20%)	0.58

Abbreviations: BMI, body mass index; SD, standard deviation.

TABLE 2. Operative data: supercharged colonic interposition.

Variable		*n* (%)
Recipient artery	Transverse cervical artery	9 (81.1)
	Internal mammary artery	0
	Superior thyroid artery	1 (9.1)
	Inferior thyroid artery	1 (9.1)
Recipient vein	External jugular vein	6 (54.5)
	Internal jugular vein	1 (9.1)
	Facial vein	1 (9.1)
	Inferior thyroid vein	1 (9.1)
	None	2 (18.2)
Pathway	Subcutaneous	11 (100)

TABLE 3. Operative data by surgical procedure.

	Supercharged colonic interposition (*n* = 11)	Gastric pull-up (*n* = 10)	*P* value
Operative time, h; median (range)	7.3 (5.3–15)	4.1 (3–7)	**< 0.001**
Estimated blood loss, mL; median (range)	925 (100–2000)	125 (50–500)	**0.01**
Length of ICU stay, days; median (range)	4 (3–8)	1 (0–10)	0.02
Hospitalization, days; median (range)	24 (14–115)	18.50 (5–58)	0.29

Abbreviation: ICU, intensive care unit.

TABLE 4. Complications, by surgical procedure.

	All patients (*n* = 21)	Supercharged colonic interposition (*n* = 11)	Gastric pull-up (*n* = 10)	*P* value
Medical complications, n (%)				
Pulmonary	6 (28.6)	4 (36.4)	2 (20)	0.63
Arrhythmia	0 (0.0)	0 (0.0)	0 (0.0)	
Vitamin D deficiency	6 (28.6)	5 (45.5)	1 (10)	0.14
Surgical complications, n (%)				
Anastomosis leak/fistula	3 (14.3)	2 (18.2)	1 (10.0)	1.00
Wound infection/dehiscence	2 (9.5)	1 (9.1)	1 (10)	1.00
Stricture	5 (23.8)	4 (36.4)	1 (10)	0.31
Gastroparesis, pyrospasm	1 (4.8)	0 (0.0)	1 (10)	0.47
Bowel obstruction	0 (0.0)	0 (0.0)	0 (0.0)	NA†
Dysphagia	1 (4.8)	0 (0.0)	1 (10)	NA†
Reflux	0 (0.0)	0 (0.0)	0 (0.0)	0.47

† "NA" indicates that the *P* values for bowel obstruction and dysphagia were not calculable due to zero events.

45.5% a soft diet. Tube feeding dependence was 27.3% in CI group vs 60.0% after GPU (Tables 5&6). Time to regular diet was longer after CI (median 50 vs 35 days). Overall survival at last follow-up was 71.4%, with deaths attributable to disease progression rather than surgical complications.

DISCUSSION

Selecting the optimal conduit for total oesophageal reconstruction remains a central challenge in upper gastrointestinal surgery, balancing operative complexity, vascular reliability, and long-term functional outcome. Successful reconstruction requires not only restoration of gastrointestinal continuity but also preservation of functional swallowing and long-term nutritional status.[1] In this study, we describe our institutional experience with supercharged CI over a 10-year period, focusing on technical strategy, perioperative management, and functional outcomes. Our findings demonstrate that with a structured operative approach and multidisciplinary perioperative management, supercharged CI can achieve reliable graft viability and satisfactory functional recovery. Our current surgical technique modifies the traditional CI by using a longer ileal segment, typically 20-30 cm

TABLE 5. Summary of outcomes, by surgical procedure.

	Supercharged colonic interposition	Gastric pull-up	*P* value
Mortality, *n* (%)			
Mortality within 30 days	0 (0.0)	0 (0.0)	NA†
Mortality within 90 days	0 (0.0)	0 (0.0)	NA†
Time to oral intake, days; median (range)	20.5 (7–90)	7 (7–32)	0.76
Time to regular diet, days; median (range)	50 (18–480)	35 (20–180)	0.84
Length of follow-up, months; median (range)	21 (13–73)	9.5 (6–37)	0.03

† "NA" indicates that the *P* values for mortality within 30 days and 90 days were not calculable due to zero events.

TABLE 6. Functional outcomes, by surgical procedure.

	All patients (*n* = 21)	Supercharged colonic interposition (*n* = 11)	Gastric pull-up (*n* = 10)	*P* value
Diet at last follow-up, ≥ 6 months; *n* (%)				
NPO	2 (9.5)	0 (0.0)	1 (10.0)	0.23
Liquid	3 (14.3)	1 (9.0)	3 (30.0)	
Soft	7 (33.3)	5 (45.5)	2 (20.0)	
Solid	9 (42.9)	5 (45.5)	4 (40.0)	
Tube feed dependence, *n* (%)	9 (42.9)	3 (27.3)	6 (60.0)	0.19
Survival status, *n* (%)				
Alive	15 (71.4)	9 (81.8)	8 (80.0)	0.64
Dead from disease	6 (28.6)	2 (18.2)	2 (20.0)	

Abbreviation: NPO, nothing by mouth (nil per os).

from the IC valve of the terminal ileum, for oesophageal reconstruction (Fig 1). This approach facilitates microvascular blood augmentation through the supercharged technique. The longer ileal segment offers several advantages: First, its smaller size compared to the ascending colon in the neck improves aesthetic outcomes and results in no perceptible peristalsis, enhancing patient confidence. Second, using a longer terminal ileum segment avoids mobilising the transverse colon, which could compromise the blood supply. Third, in cases with severe intra-abdominal scarring from previous surgery, or when the right side branch of the middle colic artery limits colon conduit use, the longer ileal segment with supercharging overcomes these limitations. Lastly, a longer ileal segment can be anastomosed at the very proximal cervical level. In some cases, we performed the esophago-ileal anastomosis just distal to the pyriform sinus.

A key challenge in CI is maintaining adequate vascular perfusion of the conduit. The marginal blood supply of the colon, particularly at the proximal graft segment, has historically been associated with an increased risk of anastomotic leakage and graft necrosis.[6,7] Microvascular supercharging has therefore been proposed to augment arterial inflow and improve conduit perfusion. Previous reports have demonstrated that vascular augmentation may reduce ischemia-related complications and improve graft survival.[9–11] In our series, arterial supercharging was performed in all CI cases, as we increasingly preferred using the transverse cervical artery. This artery is located in the lower cervical area, usually away from the zone of previous oesophagostomy—typically performed in corrosive ingestion cases—and near where the donor vessels hang after ileo-esophagogastric anastomosis. A prior report from Thailand recommended using this artery as a long pedicle in a stable position for harvesting.[13] When intraoperative congestion was observed, we also performed selective venous superdrainage. Notably, there were no instances of graft loss in our cohort, indicating that careful conduit selection combined with vascular augmentation may contribute to reliable conduit perfusion. The choice of conduit is another critical factor influencing outcomes in oesophageal reconstruction. GPU remains the most widely used reconstructive option due to its relative simplicity and dependable vascular supply.[3] However, this technique may not be feasible in patients with prior gastrectomy, compromised gastric anatomy, or extensive oesophageal defects. In such cases, CI provides several physiological advantages, including adequate conduit length, orthodromic peristalsis, and reservoir capacity.[4,5] In our institutional practice, CI is primarily reserved for patients in whom gastric reconstruction is not possible. A structured conduit selection algorithm and careful operative planning enabled consistent functional outcomes, with all patients ultimately tolerating oral intake.

Another notable aspect of our technique is the subcutaneous route for conduit placement. Although the posterior mediastinal route has traditionally been used in oesophageal reconstruction, the subcutaneous pathway offers several practical advantages. This route facilitates postoperative monitoring of the conduit and allows early detection of graft compromise through clinical inspection.[1,14] In addition, the subcutaneous route provides improved accessibility for microvascular anastomosis and may reduce operative complexity in patients with prior thoracic surgery or extensive mediastinal scarring. Our experience suggests that this approach is safe and allows reliable postoperative surveillance of the reconstructed conduit.

Despite favourable graft viability, postoperative complications remain a concern in complex oesophageal reconstruction. In our series, pulmonary complications were the most common early postoperative medical complication. Anastomotic leakage occurred in a minority of patients (2/11 CI and 1/10 GPU) but was managed without conduit loss. Oesophageal stricture was the most frequent late complication in the CI group; however, all strictures were successfully managed with endoscopic dilation. These findings are consistent with previous reports demonstrating that although strictures may occur following CI, most cases can be effectively treated with endoscopic intervention.[4]

Functional outcomes are an important measure of success following oesophageal reconstruction. In our cohort, all patients who underwent CI ultimately achieved oral intake, and a substantial proportion tolerated soft or solid diets at long-term follow-up. Although some patients required continued enteral supplementation, swallowing function was restored in most cases. These findings support previous studies demonstrating that colonic conduits can provide satisfactory long-term swallowing function and acceptable quality-of-life outcomes.[5,12]

Nutritional considerations also represent an important aspect of postoperative care following oesophageal reconstruction. Patients undergoing complex gastrointestinal reconstruction may develop micronutrient deficiencies owing to altered absorption and gastrointestinal physiologic changes. Prior studies have reported deficiencies in vitamin B12, iron, calcium, and fat-soluble vitamins following oesophageal reconstruction.[15,16] In our experience, we observed vitamin D deficiency in several patients following CI, and they required supplements, highlighting the

importance of long-term nutritional surveillance and appropriate supplementation. A more well-organised study should be conducted to explore this issue further. This study has several limitations. First, it is a retrospective, single-centre experience with a relatively small cohort. Second, conduit selection was influenced by underlying disease characteristics and prior surgical history, which introduces selection bias and precludes a direct head-to-head comparison between the two conduits. Third, functional outcomes were assessed primarily through routine clinical follow-up rather than standardised quality-of-life instruments. Despite these limitations, the series provides a detailed account of the technical strategy and perioperative management of supercharged CI within a structured institutional framework. Future multicentre studies with larger cohorts and longer follow-up are needed to refine patient-selection criteria and standardise outcome assessment with validated quality-of-life instruments.

CONCLUSIONS

In this 10-year experience, supercharged colonic interposition was associated with preserved graft viability and satisfactory functional recovery in patients requiring complex total oesophageal reconstruction.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, in accordance with institutional data-sharing policies and patient confidentiality requirements.

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Conflict of Interest

The authors declare no conflicts of interest relevant to this manuscript.

Registration Number of Clinical Trial

Not applicable.

Author Contributions

Conceptualisation and methodology, S.C, P.K., N.Y., J.S. ; Investigation, S.C., N.Y., J.S. ; Data curation, S.C., P.K., S.A., N.Y., J.S. ; Formal analysis, S.C., P.K., S.A., N.Y., J.S. ; Writing - original draft, S.C., P.K., S.A., N.Y., J.S. ; Writing - review and editing, S.C., J.S. ; Supervision, J.S. ; Project administration, J.S. All authors have read and agreed to the final version of the manuscript.

Use of Artificial Intelligence

The author declares that no AI was used to produce the manuscript.

Institutional Review Board Statement

This study was approved by the Siriraj Institutional Review Board (Si 048/2025).

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