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ORIGINAL ARTICLE

Oesophageal substitution with free and pedicled jejunum: short- and long-term outcomes

J. A. Cauchi · R. G. Buick · P. Gornall · M. H. Simms · D. H. Parikh

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Abstract In children, the indications for oesophageal substitution are principally, long gap oesophageal atresia (OA), severe anastomotic disruption following primary repair of OA and severe caustic or peptic strictures. We present an outcome review of eight cases who underwent oesophageal substitution with jejunum at our institution between 1986 and 2001. The purpose of this study was to evaluate our experience with free/pedicled jejunal grafts and its long-term outcome as an oesophageal substitute. Operative and postoperative outcome with free and pedicled jejunal grafts in four cases of pure OA, two cases of OA and distal tracheo-oesophageal fistula (TOF), one patient with a high retrolaryngeal oesophageal web and one case of severe caustic oesophageal stricture. Six patients had an oesophagostomy and a gastrostomy fashioned previously. Eleven free jejunal grafts were performed in six patients (three intraoperative redo interpositions for immediate graft loss, three separate grafts in one patient and two free grafts in two patients). One patient's pedicled jejunal graft proximally required microvascular anastomosis while the other had a pedicled graft without microvascular anastomosis. Early postoperative complications included four upper anastomotic leaks (three free grafts, one pedicled with microvascular support), pneumothorax requiring prolonged ventilation and Horner's syndrome. Recurrent laryngeal nerve injury occurred in the patient who had a high retrolaryngeal oesophageal web. During follow up (5–18 years) late complications of upper anastomotic stricture in four patients and graft redundancy with subsequent kinking of the lower anastomosis were observed in one patient. Three patients established a complete oral diet; a further three patients relied on supplemental gastrostomy feeds and one patient is entirely gastrostomy fed. There were two late deaths, one from aspiration and the other from a severe asthmatic attack (5 and 7 months postoperatively, respectively). Our results indicate that there are significant complications related to the use of free jejunal grafts. Early recognition and treatment are of paramount importance in the ultimate achievement of a successful technical outcome.

Keywords Oesophageal atresia · Oesophageal replacement · Jejunal interposition · Stricture

J. A. Cauchi · R. G. Buick · P. Gornall · D. H. Parikh (✉)
Department of Paediatric Surgery,
Birmingham Children's Hospital,
Steelhouse Lane, Birmingham B4 6NH, UK
e-mail: dakshesh.parikh@bch.nhs.uk

M. H. Simms
Department of Surgery (Vascular),
Selly Oak Hospital, Raddlebarn Road, Selly Oak,
Birmingham B29 6JD, UK

Introduction

In most cases of oesophageal atresia (OA), primary oesophago-oesophageal anastomosis is possible and produces a long-term result that is superior to any other form of oesophageal replacement. In a small minority of cases, however, primary anastomosis is not feasible and another viscus must be used to bridge the gap. Other indications for oesophageal replacement include severe peptic or caustic strictures of an unsalvageable oesophagus.

The choice of oesophageal substitute must be motivated by a consideration of the medium- and long-term growth requirements of children and should therefore provide a reliable conduit that will satisfy these needs in the long term. Jejunal substitution of the oesophagus is well described [1–3], but the use of free grafts has only been reported sporadically [4–7] in children. We present a series of eight patients in whom six had a free jejunal graft, one a pedicled jejunal graft and a further patient who had a combination of a pedicled graft with microvascular anastomosis, and discuss our experience and long-term outcomes observed in this group of patients. Our aim in this study was to evaluate and report our experience with the use of free jejunum with microvascular anastomosis of its pedicle and pedicled jejunum as an oesophageal substitute.

Materials and methods

Eight patients (five males) who underwent oesophageal replacement utilizing jejunum at Birmingham Children's Hospital (UK) between 1986 and 2001 were reviewed retrospectively. The patients' hospital records were analysed and information regarding further intervention and long-term follow up was recorded. Median follow up was 6.4 years (range 5–18 years).

Surgical management

The operation consisted of a one-stage procedure using a variety of approaches. In five patients, a median sternotomy incorporating the oesophagostomy and extending down to the umbilicus provided access to the retrosternal space. In two other patients, the combination of a lower left cervical incision, left thoracotomy and upper abdominal laparotomy incision facilitated a posterior mediastinal approach. In one patient with a previous high retrolaryngeal oesophageal web, the graft was placed across the cervical oesophagus through a neck incision after having been harvested through a midline laparotomy. Native oesophagus was kept in situ in all our cases.

The free grafts were prepared from the 4th jejunal arcade and cooled using slushed iced normal saline. The jejunal grafts were inserted isoperistaltically and microvascular anastomoses were made in the region of the proximal oesophago-jejunal anastomosis. The vessels used included the internal mammary artery and vein, external carotid artery, internal jugular vein, hemiazygos vein, aorta, subclavian artery and brachiocephalic vein. In some cases the anastomoses were bridged using the long saphenous or cephalic veins as conduits. Prolene© (8/0, 9/0 or 10/0) was used to fashion the microvascular anastomoses under magnification (loupes or operating microscope).

The pedicled graft was prepared just distal to the duodeno-jejunal flexure with a further distal 30 cm of jejunum sacrificed in order to achieve a longer vascular pedicle**.** All patients except one had a nasogastric tube left in situ. Seven patients had a drain left in the neck or chest (Fig. 1).

Results

Overall, four children had pure OA (cases 3, 4, 5 and 6), one child had a high retrolaryngeal oesophageal web (case 7). Two patients had OA and TOF (cases 1 and 8), whose primary repair was complicated by an intractable leak and irreversible anastomotic disruption, respectively. One patient had a severe caustic stricture leading to a fibrosed oesophagus (case 2).

Seven children had an oesophagostomy and feeding gastrostomy fashioned previously whilst one patient (case 2) was on total parenteral nutrition. Although the procedure of oesophageal replacement did not involve resection of the native oesophagus, none of our patients complained of symptoms suggestive of reflux oesophagitis. Furthermore, despite the theoretical risk of peptic ulceration at the level of jejuno-gastric anastomosis, none of our patients were placed on proton pump inhibitor therapy.

There were no intra-operative or operation-related deaths in this series. Cases 1 and 7 were previously reported by one of the authors (MHS) [8].

Case 1

This known asthmatic teenager, born with OA and TOF had division of the fistula and a primary oesophageal tension-free anastomosis performed on day 1 of life. An early (2 weeks) stricture dilatation was complicated by anastomotic rupture requiring re-exploration and repair. Ongoing leakage and thoracic sepsis necessitated formation of an oesophagostomy and gastrostomy at 4 weeks.

He was maintained on gastrostomy feeds until 1 year 3 months when an uncomplicated colonic interposition graft was performed. Oral feeding was well tolerated for the next 13 years. During this time an upper anastomotic stricture required revision (at 3 years) and the clinical course was highlighted by iron deficiency anaemia secondary to bleeding from peptic ulceration of the colonic graft culminating in perforation of the graft at 13 years which necessitated its

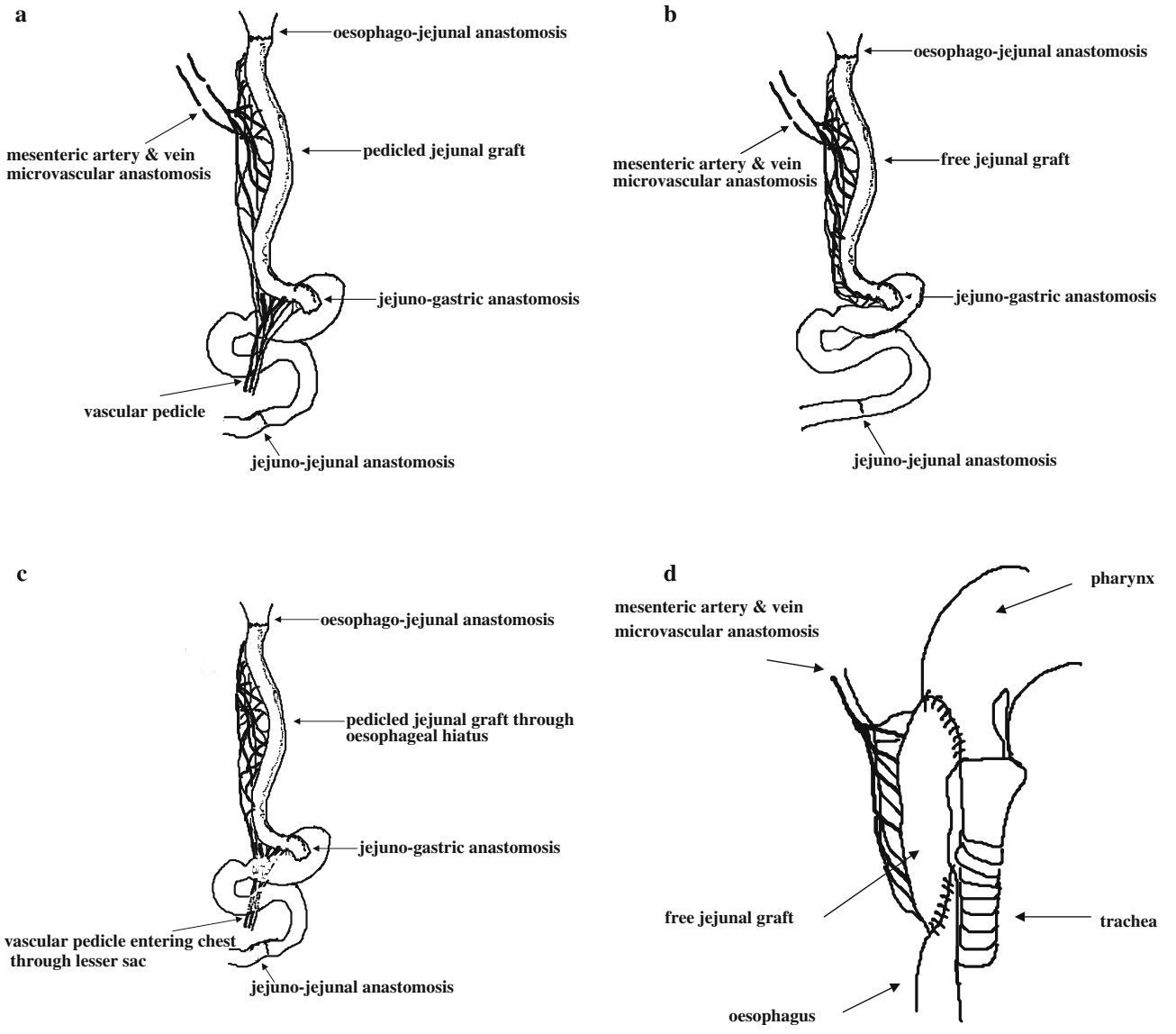

Fig. 1 **a**. Pedicled jejunal graft with cervico-thoracic microvascular anastomosis. **b** Free jejunal graft with cervico-thoracic microvascular anastomosis. **c** Pedicled jejunal graft. **d** Short free jejunal graft in cervical region

removal. Four months later, a pedicled jejunal interposition graft was placed but failed from upper end ischaemia. This was replaced by a gastric transposition which was complicated by proximal stomach necrosis 1 week later. A cervical oesophagostomy and distal stomach gastrostomy were re-established.

A second isoperistaltic pedicled jejunal graft interposition was performed at age 17 years. A microvascular anastomosis was used to augment perfusion to the oesophago-jejunal end (Fig. 1a). The postoperative course was complicated by a pneumothorax requiring ventilation for a week, a bile leak from the gastric remnant that was drained and a salivary fistula which resolved gradually. Six weeks later, this patient was discharged home on a full oral diet. The next 6 months were characterised by appropriate weight gain from a normal diet, school attendance and participation in sporting activities, although the upper anastomosis did require a single dilatation for a mild stricture. Following what seemed to be a relatively uneventful 7 months, this patient died at home from a severe asthmatic attack before he could receive medical attention.

Case 2

This child had an intractable caustic stricture from ingestion of alkali involving the cervical and most of the

upper thoracic oesophagus. A free jejunal interposition was performed at age 2 years and 6 months (Fig. 1b). Intraoperatively, his operation was complicated by thrombosis of the vascular anastomosis requiring replacement with a fresh segment of jejunum. Subsequently, however, he made an uneventful recovery and was discharged home 4 weeks postoperatively on full oral feeds including solids when use of the gastrostomy fashioned at the same time as the interposition was discontinued. A barium swallow 3 years postoperatively demonstrated free passage of contrast through the graft into the stomach with no reflux. He was discharged from follow-up on a full oral intake.

Case 3

This patient with pure oesophageal atresia underwent a free jejunal interposition (Fig. 1b) at age 1 year and 9 months. He had an uneventful postoperative course and was discharged home at 3 weeks. A barium swallow at 7 months revealed normal peristalsis as well as no stenosis. At 18 months this patient had no problems with oral feeding and has fed normally since.

Case 4

This child with pure OA and bilateral cleft lip/palate and developmental delay, underwent free jejunal graft interposition (Fig. 1b) at age 10 months. There were no intraoperative complications. She made an uneventful postoperative recovery and was discharged home 3 weeks following the procedure. An oesophagoscopy at 5 months revealed a wide patent anastomosis. She was admitted at 19 months with a chest infection and a proximal tracheo-oesophageal fistula was discovered by means of a contrast study. This was divided via a cervical approach. A barium swallow has demonstrated free flow through the graft and at 11 years postoperatively she manages a soft diet orally but still relies on gastrostomy feeds.

Case 5

This boy with pure OA underwent free jejunal graft interposition (Fig. 1b) at 9 months. Intraoperatively, his operation was complicated by thrombosis of the vascular anastomosis requiring replacement with a fresh segment of jejunum. He developed cervical superficial wound dehiscence on the fourth postoperative day. At exploration, the graft appeared intact. Ten days later, however, the proximal anastomosis broke down, and an oesophagostomy and jejunostomy were fashioned in the neck. Four months later, an oesophago-jejunostomy was performed uneventfully, but intractable strictures, unresponsive to dilatation, necessitated revision of the anastomosis 6 months later. Following an encouraging period of oral feeding, the gastrostomy was closed 7 months later in this thriving child.

At 8 years of age he presented with failure to thrive as a manifestation of a late upper anastomotic stricture which was refractory to serial dilatations. An oesophagostomy and gastrostomy were fashioned after failed dilatation. Following an adequate period of nutrition via the gastrostomy, a revision of the oesophago-jejunal anastomosis was performed 5 months later. Upper gastro-intestinal contrast studies have demonstrated redundancy and tortuosity of the jejunal graft with delayed jejuno-gastric emptying. Fourteen months following the oesophago-jejunal anastomosis, the lower anastomosis (jejuno-gastric) was explored. An S-shaped kink proximal to the anastomosis was found to be responsible for ineffective delivery of graft contents into the stomach and this was appropriately rectified. Four months following this procedure, this 12-year-old boy can manage a soft diet orally but is still dependent on gastrostomy feeds.

Case 6

This child with pure OA was the only patient with a pedicled jejunal interposition graft in this series. He underwent oesophageal replacement at age 13 months. Initially planned as a free jejunal transfer, the vascularity of the pedicled interposition at operation was considered to be satisfactory, and plans for a microvascular anastomosis were abandoned. The pedicled graft was brought up into the chest through the oesophageal hiatus with the vascular pedicle passing through the lesser sac (Fig. 1c). Apart from a transient Horner's syndrome, this patient made an uneventful recovery. He tolerates oral feeds well but relies on supplemental gastrostomy feeds.

Case 7

This child had a high retrolaryngeal oesophageal web which was initially managed by resection and primary anastomosis. A feeding gastrostomy was placed at the same time. Dilatation of the anastomotic site 2 weeks postoperatively was complicated by oesophageal rupture requiring a thoracotomy and oesophageal repair. She also required a tracheostomy and cricoid split for subglottic stenosis as a result of prolonged mechanical

ventilation. It also became apparent that there was recurrent laryngeal nerve injury. The anastomosis developed a long intractable stricture that was refractory to repeated dilatations, thus hindering the process of normal swallowing. The site of the stricture impeded the placement of an oesophagostomy and as a result the patient drooled constantly and suffered several episodes of aspiration pneumonia. She was never able to develop a swallowing reflex.

The stricture was resected and a free jejunal graft interposed (Fig. 1d) at age 2 years and 2 months. Following an initial uneventful recovery, the upper anastomosis strictured significantly after 1 month. Three months following the first graft, she was admitted for a redo free graft interposition. Two days postoperatively, she produced copious mucous discharge from the mouth and at laryngoscopy the graft was visibly ischaemic. In addition, a partial left hemiparesis was noted and believed to be due to probable embolisation related to carotid artery clamping. At exploration, the graft was found to have undergone avascular necrosis from venous infarction due to a kink in the anastomosed veins. This graft was removed and a third jejunal interposition was placed. Gastrostomy feeds were established successfully 2 weeks postoperatively. In the following 6 weeks, three anastomotic dilatations were performed. The graft has since remained patent as revealed by a barium swallow 7 years postoperatively. A distal anastomotic diverticulum has developed but it has not provided a reservoir for aspiration. Unfortunately, due to her laryngeal nerve palsy she is unable to protect her airway and has had frequent episodes of aspiration with consequent chronic suppurative lung disease, which has improved with aggressive therapy. The absence of a swallowing reflex, recurrent laryngeal nerve palsy and dependence on her tracheostomy have meant that this patient has never been able to swallow despite evidence of oesophageal continuity and as a result is entirely gastrostomy fed.

Case 8

This was a patient with OA and TOF whose primary anastomosis was complicated by severe anastomotic disruption resulting in an unsalvageable oesophagus. She underwent free jejunal graft interposition (Fig. 1b) at 12 months. Intraoperatively, her operation was complicated by thrombosis of the vascular anastomosis requiring replacement with a fresh segment of jejunum.

She developed a lower anastomotic leak 8 days postoperatively. At exploration via a left thoracotomy, the vein graft was accidentally transected and several attempts at revising the microvascular anastomosis were unsuccessful. The jejunal graft sustained irreversible ischaemic damage and had to be removed. An upper oesophagostomy was placed. This patient subsequently succumbed to a severe chest infection 5 months later.

Clinical and operative details are tabulated in Tables 1 and 2, respectively, while postoperative complications are demonstrated in Table 3. Functional outcome is summarised in Table 4.

Table 1 Clinical details of patients

	Sex	Diagnosis	Associated conditions	Previous surgical procedures			Sham feeding
				Oesophagostomy	Gastrostomy	Other	
Case 1	M	OA & TOF	–	+	+	Division of TOF and primary oesophageal anastomosis (1 day old), colonic interposition (1 year 3 months), pedicled jejunal graft (13 years), gastric transposition (13 years)	–
Case 2	M	Caustic stricture	–	–	–	CVL Insertion	–
Case 3	M	Pure OA	–	+	+	–	+
Case 4	F	Pure OA	Cleft lip and palate	+	+	Cleft lip and palate surgery	+
Case 5	M	Pure OA	–	+	+	–	+
Case 6	M	Pure OA	–	+	+	–	+
Case 7	F	High retrolaryngeal oesophageal web	–	–	+	Resection and anastomosis oesophageal dilatations, thoracotomy/repair of oesophagus tracheostomy	–
Case 8	F	OA and TOF	ASD	+	+	Division of TOF and primary oesophageal anastomosis (1 day old)	+

OA oesophageal atresia, *TOF* tracheo-oesophageal fistula, *CVL* central venous line, *ASD* atrial septal defect

Table 2 Operative details of patients

	Age at operation (months)	Indication	Jejunal conduit	Route	Intra-operative complications and action taken	Final vascular anastomoses	Additional procedure
Case 1	17 years	Proximal gastric transposition necrosis	Pedicled graft and microvascular support	Retrosternal	Nil	MA-BCA MV-IMV	–
Case 2	2 years 6 months	Caustic stricture	Free graft	Retrosternal	Graft failure replaced by second graft	MA-IMA MV-IMV	Gastrostomy
Case 3	1 years 9 months	Long gap OA	Free graft	Retrosternal	Nil	MA-IMA MV-CV-LBCV	–
Case 4	10 months	Long gap OA	Free graft	Retrosternal	Nil	MA-IMA VV-IMV	–
Case 5	9 months	Long gap OA	Free graft	Retrosternal	Graft failure replaced by second graft	MA-LSV-SCA MV-LSV-BCV	–
Case 6	1 year 1 month	Long gap OA	Pedicled graft	Posterior mediastinal	Nil	Not Applicable	Antireflux procedure and pyloroplasty
Case 7	2 years 2 months	High oesophageal web	Free graft	Cervical	Nil	MA-RSTA MV-RCFV	–
Case 7 (redo 1)	2 years6 months	Complete fibrosis of first free graft	Free graft	Cervical	Nil	MA-RCCA MV-IJV	–
Case 7 (redo 2)	2 years 6 months	Graft avascular necrosis	Free graft	Cervical	Nil	MA-ECA MV-IJV	–
Case 8	1 year	Complete disruption of primary oesophageal anastomosis	Free graft	Posterior mediastinal	Graft failure replaced by second graft	MA-LSV-Ao MV-LHAV	–

MA mesenteric artery, *MV* mesenteric vein, *IMA* internal mammary artery, *IMV* internal mammary vein, *ECA* external carotid artery, *CV* cephalic vein, *SCA* subclavian artery, *IJV* internal jugular vein, *BCA* brachiocephalic artery, *LSV* long saphenous vein, *Ao* aorta, *BCV* brachiocephalic vein, *RSTA* right superior thyroid artery, *LHAV* left hemiazygos vein, *RCCA* right common carotid artery, *RCFV*, right common facial vein

Table 3 Postoperative complications

	Early complications				Late complications			
	Graft loss	Perforation	Leak/ anastomotic breakdown	Other	Stricture	Redundancy	Dysmotility	Other
Case 1	–	–	+	Pneumothorax bile leak from gastric remnant	+	–	–	–
Case 2	–	–	–	–	–	–	–	–
Case 3	–	–	–	–	–	–	–	–
Case 4	–	–	–	–	–	–	–	CLD PTOF
Case 5	–	–	+	–	+	+	–	–
Case 6	–	–	–	Horner's Syndrome	–	–	–	–
Case 7	–	–	–	Vocal cord paralysis	+	–	–	Aspiration
Case 7 Redo1	+	–	+	Partial left hemiplegia	N/A	N/A	N/A	N/A
Case 7 Redo2	–	–	–	–	+	–	–	Distal anastomotic diverticulum chronic suppurative lung disease
Case 8	–	–	+	–	N/A	N/A	N/A	CLD

CLD chronic lung disease, *PTOF* proximal tracheo-oesophageal fistula, *N/A* not applicable

Table 4 Functional outcome

	Indication	Jejunal conduit	Feeding		Mortality
			Oral	Gastrostomy	
Case 1	Proximal gastric transposition necrosis	Pedicled graft and microvascular support	Full oral diet	–	Died 7 months postoperatively from a severe asthmatic attack
Case 2	Caustic stricture	Free graft	Full oral diet	–	–
Case 3	Long gap OA	Free graft	Full oral diet	–	–
Case 4	Long gap OA	Free graft	Soft/liquid oral diet	Partial gastrostomy feeds	–
Case 5	Long gap OA	Free graft	Soft/liquid oral diet	Partial gastrostomy feeds	–
Case 6	Long gap OA	Pedicled graft	Soft/liquid oral diet	Partial gastrostomy feeds	–
Case 7	High retrolaryngeal web	Free graft	Nil	100%	–
Case 8	Anastomotic disruption following primary repair of OA and TOF	Free graft	Nil	100%	Died 5 months postopertatively from a severe chest infection

Case 7 is entirely gastrostomy fed while the graft in Case 8 was removed a week postoperatively following accidental transection of the vascular pedicle during re-exploration for a lower anastomotic leak

Discussion

Oesophageal substitution in children is rarely undertaken; however, there are indications where interposition of an alternative viscus is required. Various interposition grafts have been utilised including colon [9], gastric tube oesophagoplasty [10], gastric transposition [11] and jejunum [1].

The jejunum has a similar diameter to the oesophagus and therefore it occupies less space within the thoracic cavity than the stomach. This is particularly important when pulmonary considerations are taken into account. Indeed, pulmonary function is reduced in patients who have undergone a gastric transposition [12]. More importantly, the jejunum retains its peristaltic activity [13], a characteristic that is highly desirable for normal transit and minimisation of stasis and reflux, even though this activity is slower than that of the oesophagus [14]. In contrast to this, peristalsis in the colon is usually absent and transit is

assisted by gravity [15]. The vascular supply of pedicled jejunum is precarious and achieving a tension-free length of jejunum may be difficult [16]. Jejunal interposition has moved from a multistage procedure [2] to a single stage operation [3]. The use of pedicled jejunal grafts in children has been well described [3]. In this technique, 30–40 cm of jejunum is sacrificed in order to produce a graft of sufficient length. Advances in microvascular techniques have facilitated the use of free jejunal transplants, and the technique of free jejunal transfer with microvascular anastomoses has been widely popularised by adult reconstructive surgeons treating pharyngo-oesophageal disease [17]. Dunn et al. [6] reported a favourable outcome with the use of free jejunal grafts in two patients, who required reoperation following a problematic course with their previous reversed gastric tube and colonic interposition, respectively. Cusick et al. [5] have described the use of a pedicled graft supported by a microvascular anastomosis in the region of the proximal anastomosis in order to ensure a well vascularised graft. The first patient in our series to undergo this procedure was case 1 whose problems with ulceration in a colonic interposition, and failed gastric transposition and pedicled jejunal graft necessitated inspired the use of a pedicled jejunal graft with microvascular anastomosis at the cervico-thoracic end in order to augment perfusion.

Combining the attractive features of jejunum with the availability of microvascular surgical expertise (by an experienced vascular surgeon), we have undertaken the use of a free jejunal transplant with a microvascular anastomosis in the region of the proximal oesophago-jejunal anastomosis This approach provides a tension-free graft and prevents loss of bowel in the preparation of a pedicled graft. On the other hand, the small vessels involved not only require microvascular surgical expertise but are also prone to thrombosis and/or spasm and obstruction secondary to kinking.

Replacing an oesophageal segment by a free jejunal graft is eminently feasible in young children. Although there were no operation-related deaths, there was significant perioperative morbidity in three patients who required the harvesting of a second graft following graft failure from irreversible thrombosis of the anastomosed vessels thus contributing to a protracted operating time. Another patient required reoperation for a failed graft 3 months later. Indeed, a failed free jejunal graft does not preclude the placement of a second jejunal graft either at the initial surgery or subsequently in contradistinction to colon or stomach.

There were four upper anastomotic leaks. In three of these patients, an aggressive surgical approach was adopted revealing an ischaemic graft in one and a viable graft in another. The third patient sadly lost the graft due to accidental division of the vascular pedicle. In a further patient, the leak settled down with a conservative approach.

Long-term follow up is of paramount importance. Late stricture developed in one of the patients several years later requiring further corrective surgery. Although redundancy of the jejunal graft was observed in one patient, graft motility has not proved to be a problem, although a prominent kink at the lower anastomosis resulted in impaired clearance of graft contents.

Chronic pulmonary disease following recurrent aspiration was noted in three of our patients. Aspiration pneumonitis was responsible for a late death in this series. This highlights the importance of establishing efficient upper oesophageal clearance of saliva as well as maintaining the continued development of the swallowing mechanism by sham feeding.

Retention of the native distal oesophagus may lead to a theoretical risk of reflux oesophagitis. In spite of this, however, none of our patients complained of symptoms suggestive of reflux. This practice of retaining the native oesophagus in situ was traditional, as it is felt that a theoretical risk of peptic oesophagitis and complications related to the retained unused oesophagus did not justify resection. However, in the light of reported complications within the retained unused oesophagus it is recommended that when feasible the native oesophagus should be resected. There is also a theoretical risk of development of peptic ulceration in the distal part of the jejunal graft. None of our patients were placed on antacid prophylaxis or developed clinical peptic ulceration. Although the prospect of using antacid prophylaxis seems sensible, in practice peptic ulceration was not an issue in our group of patients.

The objective of graft interposition of a deficient oesophagus is to provide a conduit that allows the child to swallow saliva as well as feeds. Excluding the patient with a high oesophageal web (case 7), who never established oral feeding, and the one who died of aspiration pneumonitis (case 8), the remaining six cases demonstrated evidence of oesophageal continuity and variable degrees of graft function. Half of these patients were able to swallow normally, whereas the other three relied on supplemental gastrostomy feeds. We suggest, therefore, that from a technical point of view, the operation was successful in achieving the goal of providing a conduit enabling the child to swallow both saliva and feeds in all six patients, albeit liquid/soft feeds in three patients. Closer scrutiny and comparison between these two distinct sets of patients did not

produce any significant factors either in the preoperative diagnosis and clinical course or the intraoperative/postoperative complication events to account for the two outcomes. It is interesting to note, however, that five of these six patients had an underlying diagnosis of OA. Romeo et al. [18] have shown that in OA, oesophageal motility is disordered in both proximal and distal segments prior to repair. Although the upper oesophageal sphincter response to swallowing is mostly normal, an incomplete relaxation may be seen in a proportion of swallows in some patients. Furthermore, both proximal and distal segments demonstrate a positive basal tone with total motor incoordination. Whether these inherent oesophageal motility disturbances in combination with a free jejunal graft can in part explain the inability of three of our patients (long gap OA in all) to tolerate a full oral meal is difficult to quantify. Significantly, the patient whose interposition replaced a fibrosed oesophagus from caustic injury to a previously normal oesophagus had no difficulty tolerating a full oral diet. In spite of this it has not been possible to identify any factors which might define patient suitability for free jejunal interpositions, and the small size of our group of patients makes any powerful comparison to larger series difficult and meaningful conclusions impractical.

While the use of free jejunal transplants as a means of replacing the oesophagus in children remains an attractive idea, the complication rates are discouraging. Prompt recognition and management of early or late postoperative complications has ultimately provided a satisfactory technical outcome in most of our patients. In spite of technically sound outcome, the functional results have been disappointing in 50% of patients thus far. Nonetheless, appreciation of the requirement for a long-term commitment to the management of these difficult patient's problems makes free jejunal grafts an important additional tool in paediatric oesophageal reconstruction. Our experiences with the jejunal grafts have highlighted some important lessons. The complications of the anastomotic leak in the mediastinum should be recognised early in order to avoid potential catastrophic septic complications. We now recommend excision of the native unused oesophagus when feasible; early oesophageal replacement in the long gap oesophageal atresia in the posterior mediastinum may produce better functional outcome; and the available expertise for microvascular anastomosis for the proximal jejunum if needed may reduce anastomotic leaks in a pedicled jejunal interposition.

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