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Where have all the fundoplications gone? A look at changes in national practice in England (April 2012–March 2024)

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ABSTRACT

Aim of the study: Fundoplication (FP) and transgastric jejunal tubes (GJ) are treatments for gastro-oesophageal reflux disease (GORD) where medical management has failed. GJ is less invasive than FP but requires regular radiological replacement of the tubes. We aim to assess trends in paediatric FP and GJ in England.

Method: Data were obtained from the NHS England digital platform for procedures and interventions using OPCS-4 codes G24.3 [antireflux fundoplication using abdominal approach] and Y51.2 [approach to organ through gastrostomy] from April 2012 to March 2024 for children ≤15 years. Spearman's correlation and traditional model forecasting were performed on SPSS v29. Age-based subgroup analysis was also performed [<1, 1–4, 5–9, 10–14, 15 years].

Results: The annual mean for FP was 286 (IQR: 193–371, SEM: 27), and for GJ it was 342 (IQR: 78–529, SEM: 62). Since 2012, FP has steadily decreased, while GJ has steadily increased. GJ has become more frequent than FP since 2017. Age-based subgroup analysis revealed similar trends across all age groups, except for infants under one year, where the FP decreased, while GJ remained stable and lower than FP. Spearman's test showed a strong negative correlation between FP and GJ ($R = -0.83$; $P < 0.001$). The forecasting analysis indicates that no FP will be performed on children in England after 2029 if the current trend continues.

Conclusion: Currently, GJ is performed more frequently than FP, thereby increasing the cumulative number of children requiring regular tube replacements.

1. Introduction

Gastro-oesophageal reflux is the involuntary retrograde passage of gastric contents into the oesophagus. Most episodes of reflux occur in the distal oesophagus, are brief and asymptomatic, and do not require treatment [1,2]. Gastro-oesophageal reflux disease (GORD) is a pathological condition characterised by reflux that leads to troublesome symptoms or complications, such as recurrent chest infections, failure to thrive, and apparent life-threatening events [3,4]. Most GORD cases are successfully treated by acid suppression in conjunction with feeding and lifestyle changes. However, when medical management fails, surgical treatment is considered in the form of fundoplication (FP) or post-pyloric feeding.

Rudolph Nissen performed the first antireflux FP on an adult female in 1955 [5], and it has traditionally been the standard surgical intervention for GORD after failure of medical management [6–8]. However, this surgery has a range of associated complications and side effects evident in the medium to long term, such as recurrence of symptoms, gas-bloat syndrome, retching, dysphagia and oesophageal hiatal stenosis [6,7,9–14]. The side effects are more common in neurologically impaired children, leading some clinicians to question the use of FP in these children [12].

Most children with neurodisability undergoing FP will also require a gastrostomy for feeding. Charles Sedillot performed the first gastrostomy in 1845 [15]. Martin Stamm introduced the tube gastrostomy technique in 1894 to reduce gastric leakage [16].

Abbreviations: FP, fundoplication; GJ, transgastric jejunal tubes; GORD, gastro-oesophageal reflux disease; IQR, interquartile range; NHS, National Health Service; PEG, percutaneous endoscopic gastrostomy; SEM, standard error of mean; SJ, surgical jejunostomy; TOGD, total oesophagogastric dissociation.

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Gauderer and Ponsky performed the first percutaneous endoscopic gastrostomy (PEG) in 1979 on a 4-month-old child [17]. Percutaneously placed gastrojejunal feeding tubes became an option in cases of failed FP [14]. Transgastric jejunal (GJ) tubes then emerged as an alternative to FP, primarily because of the less invasive nature of their insertion [17,18].

GJ tubes have shown significant improvements in weight gain and reductions in parenteral nutrition, hospitalisation, and GORD complications [4]. A recent survey in Canada has shown that the GJ tube alone is the preferred antireflux procedure among paediatricians [3]. This approach is particularly favoured in neurologically impaired children due to the high failure rates of FP [3,12,13,17–19]. Nonetheless, GJ tubes are not without complications, including intestinal perforation, intussusception, displacement, blockage, and device failure, necessitating replacement at regular intervals [4,17,20,21].

Total oesophagogastric dissociation (TOGD) has been used as a surgical option when FP fails [22–24]. Feeding surgical jejunostomy (SJ) can be used as an alternative primary treatment for GORD or after failure of FP or GJ [25,26].

In our centre, we observed a steady decline in FP from 23 procedures in 2016 to 3 procedures in 2022. We hypothesised that fewer FP are being performed in England. Our aim was to examine the current trends in FP and placement of GJ.

2. Methodology

Hospital episode statistics were accessed from the NHS England Digital platform, specifically in the 'Hospital Admitted Patient Care Activity: Procedures and Interventions' section [27]. The data is open-source, which can be reused free of charge in any format or medium under the terms of the Open Government Licence v3.0. No further ethical approval is required. The data was available for each financial year (April to March). This paper used 2023 to represent the data from April 2023 to March 2024, and so on, for easier representation.

OPCS-4 codes were used to identify the procedures performed in children aged up to 15 years. For FP, the code was G24.3: antireflux fundoplication using abdominal approach, and for GJ placement, it was Y51.2: approach to organ through gastrostomy. Our hospital clinical coding department validated Y51.2 as the correct code for GJ tube insertions. Y51.2 is a secondary procedure code and must be combined with a primary procedure, such as the creation of a gastrostomy. Therefore, this code will only pick up the primary GJ insertions and not the replacements. We also looked at other codes related to jejunal tubes, such as G60.4: attention to jejunostomy tube, and G67.4: intubation of jejunum NEC (Fig. 1).

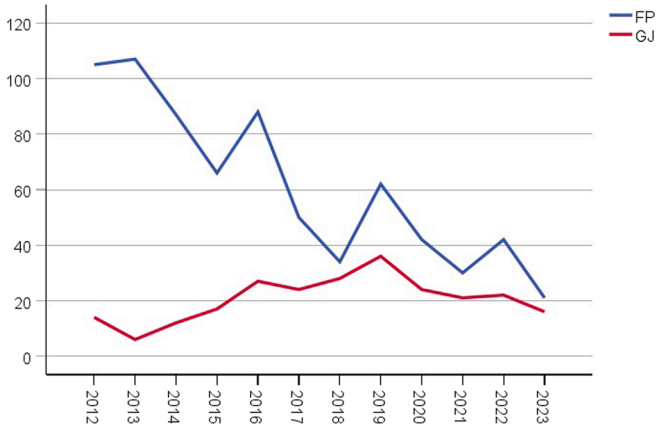

Fig. 2. Yearly frequency of FP and GJ in children under 1 year of age.

For SJ, we used G60.1: creation of jejunostomy. As there are no separate codes for feeding jejunostomy and defunctioning jejunostomy, some children included in this code may have had a jejunostomy created for faecal diversion in conditions such as necrotising enterocolitis or small intestinal volvulus. The code for gastric bypass, G33.1: Bypass of stomach by anastomosis of stomach to jejunum NEC, was used to identify TOGD cases.

Data were presented as mean, interquartile range (IQR), and standard error of mean (SEM). SPSS v29 was used for data analysis. Spearman's correlation was performed to assess the relationship between the frequencies of each procedure. Traditional model forecasting was conducted to predict future trends. Age-based subgroup analyses were performed for the following groups: <1, 1–4, 5–9, 10–14, and 15 years. A P-value of $\leq$0.05 was considered significant.

3. Results

Between 2012 and 2023, 3462 FP and 4109 GJ were performed. The annual mean for FP was 286 (IQR: 193–371, SEM: 27), and for GJ it was 342 (IQR: 78–529, SEM: 62). FP has continuously decreased since 2012, whereas GJ placements have significantly increased. By 2017, GJ had surpassed FP (Fig. 1). Although there was a gradual decline in GJ starting in 2020, it was still higher than FP.

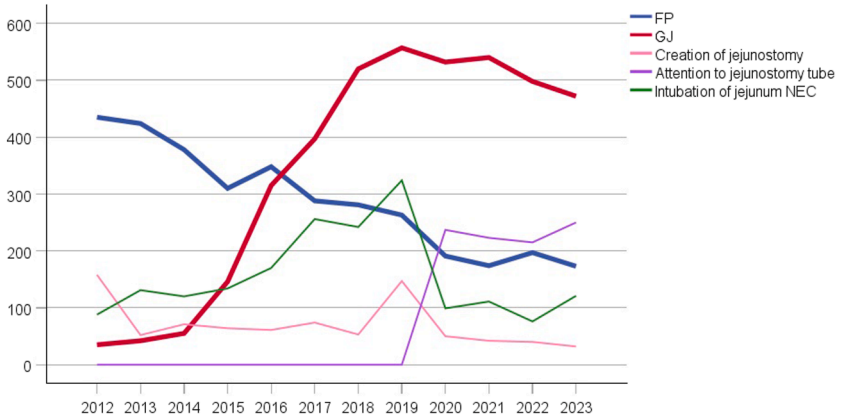

Fig. 1. Yearly frequency of OPCS-4 Codes: G24.3 – antireflux fundoplication (FP) using abdominal approach, Y51.2 – approach to organ through gastrostomy (GJ), G60.4 – attention to jejunostomy tube, G60.1 – creation of jejunostomy, and G67.4 – intubation of jejunum NEC.

Spearman's correlation revealed a strong and statistically significant inverse relationship between FP and GJ placement over time ($R_S = -0.83$; $P < 0.001$).

All age categories had a decrease in FP, but infants under one year saw the most significant decline, with instances falling to one-fifth during this period. It is interesting to note that this age group showed no discernible changes in GJ insertion, which stayed below FP throughout the study period (Fig. 2). In all other age groups, GJ, which was initially less prevalent, increased steadily and surpassed FP between 2016 and 2017. However, as the children got older, the rate at which FP declined became less significant (Fig. 3).

The forecasting analysis predicted that FP would become nearly obsolete by 2029 if current trends continue. Similarly, it is anticipated that GJ tube utilisation will either stay constant or slightly decline (Fig. 4).

The code G60.4, attention to jejunostomy tube, has been used since 2020, and G67.4, intubation of jejunum NEC, appears to have decreased as the use of G60.4 started (Fig. 1). Both codes could represent GJ replacements when performed in operating theatres.

The highest number of 23 TOGD cases was reported in 2018, and the lowest number, 5 cases, was reported in 2019, with no discernible trend. Similarly, no trend was observed in SJ. The annual mean for the creation of jejunostomy was 70 (IQR: 46–73, SEM: 12) (Fig. 1).

4. Discussion

This national study reveals a clear decline in the annual number of FP procedures performed over the past 12 years. This trend has also been shown in the USA. Maassel et al. used the Pediatric Health Information System (PHIS) database for the period 2010–2019, involving data from 46 children's hospitals. They found that the annual institutional volume initially was 50 and dropped to 17 by the end of the period [28].

Historically, FP has been widely regarded as the standard of care for severe GORD refractory to medical treatment [8,29–31]. However, there have been concerns about long-term efficacy and complications, including retching, dysphagia, and wrap failure/migration [3,9,10,13,14,32]. GJ tubes have been increasingly adopted as a reversible and less invasive alternative, particularly for children with neurological impairment [4,17,19–21,33]. The North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) guidelines now recommend GJ tubes as a rational alternative to FP [30].

We looked for evidence of an increase in surgical alternatives such as TOGD. However, there was no change in the number of TOGD performed over the period. SJ has also been used as a primary treatment for GORD, and in children where FP and GJ have failed [25,26,34,35], but it is more invasive. In some children with SJ, an additional gastrostomy is required either for drainage or for weaning to bolus feeds, particularly in children with neurological impairment with unsafe swallowing. Although tube replacements are easier following SJ, some surgeons still prefer to confirm the tube's position radiologically [26]. SJ can also be associated with major complications, such as perforation, intestinal obstruction, and volvulus [25,26,34,35]. Over the period, there was no change in the number of SJ performed. However, we acknowledge that SJ data may be inaccurate, as we were unable to distinguish between surgical jejunostomies performed for feeding and those created for faecal diversion in conditions such as necrotising enterocolitis or

Fig. 3. Yearly frequency of FP and GJ in children between 1 and 15 years of age.

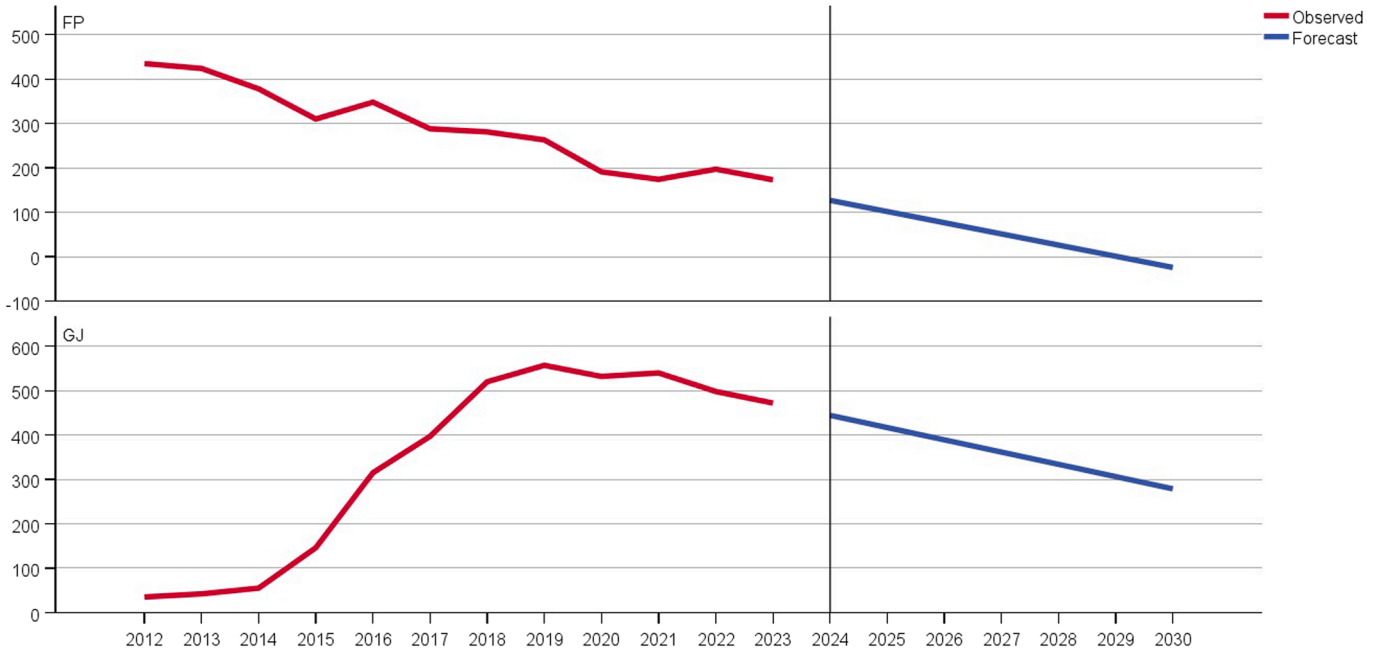

Fig. 4. Forecasting analysis of FP and GJ.

small intestinal volvulus. There is a single procedure code G60.1 for the creation of a jejunostomy, regardless of whether it is intended for feeding or diversion.

In England, paediatric gastroenterologists diagnose GORD, and patients are referred to paediatric surgeons for intervention when medical management has failed. The decision to perform FP or GJ depends primarily on the surgeon. In the UK, most gastrostomies in children are performed by paediatric surgeons, as most procedures are laparoscopic [36]. Radiologists usually perform the replacements under fluoroscopy without any sedation or anaesthesia [37]. Surgeons and endoscopists can also replace GJ tubes endoscopically when radiological tube placement has failed. However, those procedures are usually performed under general anaesthesia.

Although GJ tubes present challenges, including the necessity for continuous feeding and frequent replacements, they are linked to fewer manageable minor complications when compared to the risk of major complications associated with FP [19]. However, GJ can also delay the development of normal eating and drinking skills [38]. GJ can fail due to frequent intussusception, tube dislodgement, and jejunal perforation. However, GJ failures most commonly result from intrinsic structural or mechanical issues [39].

The reciprocal increase in GJ when FP is decreasing is not unexpected. In infants under the age of one year, there was a lower GJ despite a significant reduction in FP, which suggests a trend toward decreased surgical interventions in this age group. Several factors may have contributed to the outcome, such as a more effective response to medical management or the use of a nasojejunal (NJ) tube feeding.

Our forecasting model projects that FP may become virtually obsolete by 2029 if current trends persist. Maassel et al. reported a similar trend in the United States [28]. However, forecasting is most reliable for only a short period, and it does seem rather unlikely that FP will not be performed at all in children beyond 2029.

We also noted a modest decline in GJ since the peak in 2019. The drop in both GJ and FP would suggest a trend towards fewer surgical interventions for GORD with more effective antireflux medical management. However, our data only represent the new insertion of GJ and not the replacements. The radiology workload of GJ replacements is likely to remain high, despite a modest drop in new GJ insertions, due to improved life expectancy in the UK [40].

By performing more GJs, we have created an expanding cohort of children requiring emergency and elective radiological tube replacements. With the current national shortage of paediatric radiologists, the workload is becoming increasingly complex. Training nurses and allied health professionals to perform tube replacements may be an option for the future.

This study has several limitations. There is a lack of clinical stratification and granularity in the national dataset. For example, we do not know those who have significant neurological impairment, one of the key reasons for intervention and a source of many complications. Similarly, the dataset did not allow for comparisons between different hospitals and regions, limiting the ability to assess regional variation. Although our local coding team provided the codes used in this study, other centres may have used different codes for the same procedure, leading to an underestimate of procedures.

In conclusion, in England, the use of GJ for gastro-oesophageal reflux is becoming more common than FP and may replace it entirely in the next few years. A detailed analysis, including patient backgrounds and variations in regional practice, is essential for a deeper understanding of this change in practice.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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