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RESEARCH

Minimal access surgery compared with medical management for gastro-oesophageal reflux disease: five year follow-up of a randomised controlled trial (REFLUX)

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Abstract

Objectives To determine the long term clinical effectiveness of laparoscopic fundoplication as an alternative to drug treatment for chronic gastro-oesophageal reflux disease (GORD).

Design Five year follow-up of multicentre, pragmatic randomised trial (with parallel non-randomised preference groups).

Setting Initial recruitment in 21 UK hospitals.

Participants Responders to annual questionnaires among 810 original participants. At entry, all had had GORD for >12 months.

Intervention The surgeon chose the type of fundoplication. Medical therapy was reviewed and optimised by a specialist. Subsequent management was at the discretion of the clinician responsible for care, usually in primary care.

Main outcome measures Primary outcome measure was self reported quality of life score on disease-specific REFLUX questionnaire. Other measures were health status (with SF-36 and EuroQol EQ-5D questionnaires), use of antireflux medication, and complications.

Results By five years, 63% (112/178) of patients randomised to surgery and 13% (24/179) of those randomised to medical management had received a fundoplication (plus 85% (222/261) and 3% (6/192) of those who expressed a preference for surgery and for medical management). Among responders at 5 years, 44% (56/127) of those randomised to surgery were taking antireflux medication versus 82% (98/119) of those randomised to medical management. Differences in the REFLUX score significantly favoured the randomised surgery group (mean difference 8.5 (95% CI 3.9 to 13.1), P<0.001, at five years). SF-36 and EQ-5D scores also favoured surgery, but were not statistically significant at five years. After fundoplication, 3% (12/364) had surgical treatment for a complication and 4% (16) had subsequent reflux-related operations—most often revision of the wrap. Long term rates of dysphagia, flatulence, and inability to vomit were similar in the two randomised groups.

Conclusions After five years, laparoscopic fundoplication continued to provide better relief of GORD symptoms than medical management. Adverse effects of surgery were uncommon and generally observed soon after surgery. A small proportion had re-operations. There was no evidence of long term adverse symptoms caused by surgery.

Trial registration Current Controlled Trials ISRCTN15517081.

Introduction

Trials of laparoscopic fundoplication surgery[1-8] provide promising evidence of better short term symptomatic relief than continued medical management among people who would otherwise require continuous or intermittent medication for reasonable control of gastro-oesophageal reflux disease (GORD). Uncertainty remains about whether benefits are sustained and outweigh risks, subsequent drug use, and unwanted symptoms such as dysphagia and flatulence.[7] We therefore undertook five year follow-up within a multicentre, UK based, randomised controlled trial, the REFLUX trial.

Methods

Design and participants

The study was approved by the Scotland A Multicentre Research Ethics Committee (MREC/00/0/30). The design and one year results have been reported previously,[1 2 9] and a detailed report of the follow-up is also available.[10] The trial was pragmatic[11] comparing a policy of laparoscopic fundoplication with a policy of optimised continued medical management. Patients were

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eligible if they had more than 12 months' maintenance treatment with a proton pump inhibitor (or alternative) for reasonable control of GORD symptoms, they had evidence of GORD (endoscopic or 24 hour pH monitoring, or both), they were suitable for either policy, and the recruiting doctor was uncertain which management policy to follow.

Clinical management

Participating clinical centres had partnerships between surgeons and gastroenterologists who shared the secondary care of patients with GORD. They assessed eligibility and, working with research nurses, informed participants about the trial. Randomisation was organised centrally and computer generated. Participants who declined to take part in the randomised trial because of a strong preference either for remaining on medical management or for undergoing surgery were then given the opportunity to join one of two non-randomised preference arms.[12] All participants gave informed consent.

For all participants in either the randomised or preference surgical groups, surgery could be deferred or declined after trial entry, by either the patient or the surgeon. A lead surgeon who had performed at least 50 laparoscopic fundoplication operations (or a surgeon working under supervision) undertook the surgery. The type of fundoplication was decided by the surgeon. We considered the different fundoplication techniques as a single policy. Those allocated to medical treatment had their treatment reviewed and adjusted as judged best by a local gastroenterologist.[13] The medical protocol included the option of surgery if a clear indication developed after randomisation. In all groups, subsequent management was decided by the clinician responsible for care; most later care was in general practice.

Outcome measures

The primary outcome was the score from the REFLUX questionnaire,[14] a validated measure of health related quality of life for patients with GORD that incorporates assessment of reflux related and other gastrointestinal symptoms and the side effects and complications of both treatments (scores ranged from 0 to 100, with the higher the score the better the patient felt). Other measures were health status (SF-36[15] and EuroQol EQ-5D[16]), use of antireflux drugs, reflux related surgery and its complications, and individual symptoms. Participants were followed up by postal questionnaire (copies available on request) at equivalent to 3 and 12 months after surgery, and subsequently annually for five years.

Sample size and statistical analysis

The original sample size of 176 per group was chosen to give 80% power (α=0.05) to detect a difference of 0.3 of one standard deviation (equivalent to 7 points) in the REFLUX questionnaire score. Secure randomisation was organised centrally using a computer generated sequence, stratified by clinical site, with balance in age, sex, and body mass index secured by minimisation.[2] There was no subsequent blinding. Figure 1⇓ summarises the stages of the study in a CONSORT diagram.

Primary statistical analysis in the randomised comparison was by intention to treat. The REFLUX questionnaire score, SF-36, EQ-5D, and antireflux drug use were analysed using general linear models. The analyses were adjusted for the minimisation covariates; in addition, the randomised comparisons were also adjusted for baseline REFLUX questionnaire scores and for baseline by treatment interaction. Sensitivity to assumptions about missing values was explored using a repeated measures analysis.[17] Secondary "adjusted treatment received" analyses [18] were based on actual treatment in the first year. These are similar to per protocol analyses but are less prone to bias; they give a measure of efficacy of surgery when compared with medical management.

Results

Recruitment took place in 21 UK centres between March 2001 and June 2004: 357 patients recruited to the randomised comparison (178 to surgery and 179 to medical management) and 453 recruited to non-randomised preference groups (261 for surgery and 192 for medical management).

Description of trial groups

As described previously,[1 2] the randomised groups were balanced at trial entry. Follow-up rates decreased over time (318/357 (89%) at 1 year to 246/357 (69%) at 5 years). Four randomised participants are known to have died by five years—none related to trial participation. Respondents at five years tended to have been older at entry, to have been prescribed medication for a shorter time before recruitment, and to have had higher baseline quality of life scores. However, other than in baseline body mass index (table 1⇓), respondents at five years were similar in the two randomised groups. The baseline characteristics of the randomised groups lay between those of the preference groups: members of the group who expressed a preference for surgery were younger, had been prescribed drugs for GORD for longer, and had lower baseline REFLUX scores; participants who preferred medical treatment were older, more likely to be women, had been prescribed medication for a shorter time, and had higher baseline REFLUX scores.

Clinical management

By five years, 112 (62.9%) of the 178 patients randomised to surgery had received fundoplication (table 2⇓)—53 (47.3%) with a total wrap and 59 (52.7%) with a partial wrap. Surgery was also performed for 24 (13.4%) of the 179 patients randomised to medical management—10 in the first year and 14 in years 2–5; post hoc analyses showed that these 24 had significantly lower baseline REFLUX questionnaire scores than those randomised to medical management who did not have surgery. Of the total of 364 patients who had fundoplication (randomised and preference groups), 16 (4.4%) had a subsequent reflux related reoperation—mainly a reconstruction of the same wrap or conversion to another type of wrap—and 12 (3.3%) had a late complication (table 2⇓).

Figure 2⇓ shows the use of antireflux drugs in the four participant groups based on intention to treat. This applied to 37.7% (58/178) of those randomised to surgery versus 90.2% (148/179) of those randomised to medical management at one year follow-up and to 44.1% (56/127) versus 82.4% (98/119) at five years. The equivalent rates among those randomised to surgery who had surgery in the first year were 9.6% (10/104) at one year rising to 26.7% (24/90) at five years. The most commonly prescribed proton pump inhibitors were omeprazole, lansoprazole, and esomeprazole.

Health status and symptoms

The REFLUX questionnaire mean scores at all follow-up time points were highest in the groups randomised to surgery or who preferred surgery (fig 3⇓). The differences between the surgical and medical groups narrowed over time, principally because the scores for the group randomised to medical treatment

improved over the first three years. However, there were still clear differences between the randomised groups at five years: mean difference 8.5 (95% confidence interval 3.9 to 13.1, P<0.001) for intention to treat, 11.5 (4.2 to 18.7, P=0.002) adjusted for treatment received; and 8.1 (4.4 to 11.7) for repeated measures analysis.

Heartburn, regurgitation, and belching were reported less frequently in the group randomised to surgery than among those randomised to medication, with no significant differences in 'difficulty swallowing', 'wind from the bowel' and 'wanting to be sick but being unable' (table 3⇓).

SF-36 scores favoured the surgical group in all domains at all time points. Differences decreased over time, and this decrease is reflected in most P values being <0.05 up to three years' follow-up, whereas at five years only the norm-based general health and role emotional domains had P values <0.05 (table 4⇓). Mean EQ-5D scores showed a similar pattern—differences all favouring the surgical group but tending to narrow so that scores at years 2 and 3 were significantly different but not at later time points (table 4).

Preference groups

The preference surgery group had a markedly lower mean REFLUX score at baseline than the preference medical group (55.8 *v* 77.5, equivalent to 1 SD). Despite this, all subsequent scores favoured the preference surgery group (fig 3⇓). Other quality of life scores showed a similar pattern.

Discussion

Principal findings

After five years, a policy of laparoscopic fundoplication among patients for whom reasonable control of GORD symptoms required long term medication and for whom both surgery and medical management were suitable continued to provide better relief of GORD symptoms with associated improved health related quality of life. Despite some narrowing over time, the difference in the primary outcome measure remained highly significant at five years. There was reassuringly little evidence of new chronic symptoms caused by surgery. Reoperations and complications of surgery occurred early after surgery and were uncommon.

Strengths and weaknesses of study

The trial design was pragmatic, aiming to make clinical management similar to normal NHS care, and so the results should be generalisable to standard care. The trial compared two policies for managing GORD (intention to treat analyses) rather than directly comparing surgery with antireflux medication. The first policy was earlier surgery for eligible patients, when deemed appropriate and acceptable, with the option to take medication if considered helpful. The second policy was continued, initially optimised, medical management, with "delayed" surgery in selected cases when considered indicated.

Recruiting patients for randomisation to such markedly differing managements as surgery and medical treatment is challenging. Patients who agree to be randomised have to be uncertain between the two approaches, and hence it should be expected that they sometimes change their minds once they discuss and reflect on the implications of their allocation. These circumstances are largely responsible for the apparently low rate of surgery among those randomly allocated surgery (112/178 (63%), table 1⇓) compared with those who expressed a preference for surgery (218/261 (83%)). Among those allocated surgery who did not have surgery in the first year, a definite decision was later made not to have an operation for 47. For 25 of these, this was a clinical decision—most commonly the surgeon deciding after randomisation that surgery was not appropriate. Most of the others changed their minds about having surgery for a variety of work or home related reasons, because of worries about having surgery (after a fuller discussion with the surgeon), because of a wish to avoid unpleasant preoperative tests, or because their symptoms had improved. In addition to these 47, a further 20 withdrew for unknown reasons. There is no doubt that some of these participants experienced long delays before formally being offered surgery, and we believe that this was an important factor in their eventual decision not to have surgery after all. Recruitment and early treatment in the trial was conducted in 2001–4, when there was great pressure on surgical services in the NHS, and long delays for elective surgery for non-life threatening, benign conditions were common. (Average time between trial entry and surgery in the trial was 8–9 months.)

Despite only 63% of those allocated surgery actually receiving it, there were still clear differences in outcome between the intention to treat groups. However, the analyses adjusted for treatment received probably give better estimates of differential effects in the randomised comparison in terms of efficacy. As would be expected, these analyses gave larger estimates (11.5 *v* 8.5 for intention to treat), but they are more prone to bias.

The 69% response rate at five years is similar to the 67% reported for the LOTUS clinical trial.[7] The responders in the randomised groups were generally similar in baseline characteristics (table 1⇓). Although responders did show some differences from non-responders, it is reassuring that the repeated measures analysis that uses data from all follow-up points gave broadly similar results to the intention to treat analyses.

The 24 (13%) of the 179 participants randomised to medical management who subsequently had surgery had significantly lower baseline REFLUX questionnaire scores, which then improved markedly. This group contributed to the narrowing of differences over time between the two randomised groups (fig 1⇓), and this is another reason why the analyses based on intention to treat are likely to underestimate the effects of surgery. Some participants did take medication intermittently. The estimated longer term use of antireflux drugs (fig 2⇓) was based on participants' recall of the preceding two weeks and may not fully reflect use over the entire year.

We anticipated that some eligible patients would have strong preferences for their future management, especially when clinical uncertainty was expressed. We gave these patients the opportunity to participate in non-randomised preference groups. These groups do aid the interpretation of the randomised trial results in important ways: they provide added data on rare but serious complications; they contextualise the randomised cohort (which sits between the preference groups in terms of baseline characteristics); they add further evidence of the effects of surgery (the preference surgery group started with much lower REFLUX questionnaire scores but had high scores after surgery); and they provide better guides to real world management in terms of surgical take up.

Comparison with other studies

Four randomised trials have compared laparoscopic fundoplication with medical management of GORD.[1-8 19] The REFLUX trial had the most pragmatic design—for example,

greater flexibility in the choice of surgical procedure. Also, other trials incorporated regular specialist assessment of antireflux medication and adjustment, whereas in REFLUX, after initial review by a gastroenterologist, all subsequent prescription was decided by the clinician responsible for normal care, usually in primary care.

All four trials show significantly better relief of symptoms over their length of follow-up. Limited data are available for generic quality of life measures: while differences are less marked, they are consistent with benefit from surgery. The trials are also broadly consistent in showing small numbers of operations needing to be converted to an open procedure, visceral injuries associated with the procedure, postoperative problems, and numbers requiring dilatation of the wrap. The REFLUX trial suggests that 4.4% (16/364) have reoperations over five years, broadly consistent with other trials.

The REFLUX trial's main outcomes were patient reported, providing "common currency" across trial policies independent of clinical judgment. In contrast, the primary outcome in the other large trial (LOTUS[6 7]) was "treatment failure" as judged by cross over to the alternative treatment—all surgical patients who developed a need for medication were classified into this category whether or not their GORD symptoms were satisfactorily controlled by that medication. A concern about using patient reported outcomes is that completion of questionnaires might be influenced by knowledge of management received, but this possibility is likely to become more remote as follow-up lengthens. Also, the randomised component was limited to patients who were uncertain which treatment to choose (those with strong views were enrolled into the preference groups).

Where the REFLUX trial results differ from those of the other trials, especially LOTUS,[6 7] is the low prevalence of chronic adverse symptoms associated with fundoplication. Although a small number in the REFLUX trial did have a postoperative dilatation procedure,[1 2] later reports of difficulty swallowing, flatulence, and wanting to vomit but being unable to do so were similar in the two randomised groups (table 3⇓). These differences between trials are important as they potentially alter the balance between benefits and risks of surgery. A possible explanation is the difference in fundoplication policies. In REFLUX, the choice of operation was left to the surgeon, and a high proportion of patients (53%) had a partial fundoplication. In the LOTUS trial, a standardised protocol specified total Nissen fundoplication.[20] Partial fundoplication is associated with a lower rate of postoperative side effects but may have a higher rate of reoperation for recurrence of GORD.[21]

Meaning of the study

Five year follow-up has shown that laparoscopic fundoplication for patients for whom reasonable control of GORD symptoms requires long term medication, and for whom both surgery and medical management are suitable, continued to provide better relief of symptoms with associated improved quality of life. The more troublesome the symptoms at baseline, the greater the potential benefit from surgery. Decisions about surgery will be informed by the balance between benefits and risks. In this study, complications were rare and, unlike in other studies, there was no evidence that surgery caused long term unwanted symptoms such as difficulty swallowing.

Unanswered questions and future research

Patients and doctors making decisions about laparoscopic fundoplication would be aided by clearer evidence about the risks of long term morbidity and its associations with surgical technique. People with GORD are usually managed in primary care, and it is not clear currently how many such people might seek fundoplication in light of the findings of this and other trials.

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What is already known on this topic

Laparoscopic fundoplication surgery provides better short term symptomatic relief than continued medical management for people with chronic gastro-oesophageal reflux disease (GORD)

Uncertainty remains about whether benefits are sustained and possible long term side effects such as dysphagia and flatulence

What this study adds

Five year follow-up of trial participants confirmed sustained benefits of surgery as an alternative to drug treatment for GORD

Adverse effects of surgery were uncommon and generally observed soon after surgery

Unlike in some other studies, unwanted long-term symptoms were not associated with surgery in this trial

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Ethical approval: The study was approved by the Scotland A Multicentre Research Ethics Committee (MREC/00/0/30).

Data sharing: An anonymised study dataset is available on request subject to resource implications and proposed use.

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Tables

Table 1| Baseline characteristics of respondents at five year follow-up by randomisation to surgical or medical management for chronic gastro-oesophageal reflux disease. Values are numbers (percentages) of participants unless stated otherwise

Characteristic	Surgical (n=127 maximum)	Medical (n=119 maximum)	P value of difference*
Mean (SD) age in years	48.5 (9.3) (n=127)	46.4 (11.6) (n=119)	0.12
Sex:			
Men	79/127 (62)	76/119 (64)	0.79
Women	48/127 (38)	43/119 (36)	—
Mean (SD) body mass index	29.0 (4.3) (n=127)	27.7 (3.8) (n=119)	0.01
Mean (SD) months of antireflux medication before trial entry	57.2 (63.4) (n=124)	46.3 (60.1) (n=117)	0.17
Erosive oesophagitis:			
Yes	63/111 (57)	68/108 (63)	0.35
No	48/111 (43)	39/108 (36)	—
H pylori infection status:			
Positive (treated)	6/96 (6)	10/92 (11)	0.52
Positive (untreated)	1/96 (1)	2/92 (2)	—
Negative	55/96 (57)	45/92 (49)	—
Uncertain	34/96 (35)	34/92 (37)	—
Hiatus hernia:			
Yes	73/117 (62)	71/114 (62)	0.99
No	44/117 (38)	43/114 (38)	—
Mean (SD) questionnaire scores:			
REFLUX†	65.9 (23.7) (n=121)	68.6 (24.0) (n=110)	0.38
EQ-5D‡	0.736 (0.223) (n=122)	0.755 (0.228) (n=118)	0.51
SF-36 physical§	44.8 (10.0) (n=121)	46.1 (9.1) (n=114)	0.30
SF-36 mental§	46.6 (11.0) (n=121)	46.5 (11.1) (n=114)	0.98
Taking any proton pump inhibitor	120/125 (96)	109/118 (92)	0.23
Taking any antireflux drug	124/125 (99)	113/118 (96)	0.11

*Using Student's *t* test, χ^2 test, or Fischer's exact test as appropriate.

†REFLUX questionnaire a disease-specific measure of quality of life (score range 0–100).

‡EuroQol EQ-5D measure of health status.

§Short Form (36) Health Survey measure of health status.

Table 2| Reflux related surgery and subsequent complications among participants with chronic gastro-oesophageal reflux disease who were randomised to or selected surgical or medical management. Values are numbers (percentages) of participants

	Participants randomised to treatment		Participants with preferred treatment		
	Surgical (n=178)	Medical (n=179)	Surgical (n=261)	Medical (n=192)	Total cohort
Fundoplication within 1 year of enrolment	111 (62.4)	10 (5.6)	218 (83.5)	3 (1.6)	
Fundoplication at any time during 5 year follow-up	112 (62.9)	24 (13.4)	222 (85.1)	6 (3.1)	
Reflux related re-operation:	5 (4.5)	1 (4.2)	8* (4.5)	2 (33.3)	16 (4.4)
Reconstruction of same wrap	2	1	2	1	6
Conversion of type of wrap	2	0	4	0	6
Reversal of fundoplication	0	0	1	1	2
Repair of hiatus hernia only	1	0	3	0	4
Late postoperative complication†:	2 (1.8)	0	8 (3.6)	2 (33.3)	12 (3.3)
Oesophageal dilatation or stricture dilatation	1	0	3	0	4
Repair of incisional hernia	0	0	3	0	3
Other	1‡	0	2§	2¶	5

*Two of the eight also had a third reflux related operation.

†Complication ≥1 month after operation.

‡Pain due to original wrap shifting.

§Admission for venous thromboembolism; pain from operation.

¶Hole between stomach and liver; bleed in stomach and/or bowel.

Table 3| **Frequency of related symptoms among participants at three and five year follow-up after randomisation to surgical or medical management for chronic gastro-oesophageal reflux disease. Values are numbers (percentages) of participants**

Symptom frequency (No of times/week)	Year 3 follow-up		Year 5 follow-up	
	Surgical	Medical	Surgical	Medical
Heartburn:				
0	77 (58.8)	46 (34.8)	65 (58.6)	28 (26.4)
1–3	44 (33.6)	64 (48.5)	38 (34.2)	64 (60.4)
>3	10 (7.6)	22 (16.7)	8 (7.2)	14 (13.2)
Regurgitation:				
0	102 (77.3)	83 (61.9)	89 (75.4)	71 (63.4)
1–3	27 (20.5)	47 (35.1)	26 (22.0)	37 (33.0)
>3	3 (2.3)	4 (3.0)	3 (2.5)	4 (3.6)
Difficulty swallowing:				
0	100 (75.8)	102 (76.1)	91 (77.1)	82 (74.5)
1–3	30 (22.7)	27 (20.1)	25 (21.2)	25 (22.7)
>3	2 (1.5)	5 (3.7)	2 (1.7)	3 (2.7)
Wind from bowel:				
0	19 (14.4)	20 (15.0)	14 (11.9)	14 (12.7)
1–3	37 (28.0)	35 (26.3)	27 (22.9)	30 (27.3)
>3	76 (57.6)	78 (58.6)	77 (65.3)	66 (60.0)
Belching:				
0	53 (40.2)	33 (24.8)	46 (39.3)	27 (24.5)
1–3	39 (29.5)	48 (36.1)	40 (34.2)	37 (33.6)
>3	40 (30.3)	52 (39.1)	31 (26.5)	46 (41.8)
Nausea but unable to be sick:				
0	116 (87.9)	110 (83.3)	101 (85.6)	92 (82.9)
1–3	15 (11.4)	17 (12.9)	15 (12.7)	16 (14.4)
>3	1 (0.8)	5 (3.8)	2 (1.7)	3 (2.7)

Table 4| Differences at five year follow-up in self reported outcomes between participants randomised to surgery and those randomised to medical management for chronic gastro-oesophageal reflux disease

	Intention to treat		Adjusted for treatment received	
	Mean difference (95% CI)*	P value	Mean difference (95% CI)*	P value
REFLUX total score†	8.3 (3.2 to 13.4)	0.001	11.6 (3.5 to 19.8)	0.005
REFLUX symptom scores:				
General discomfort	11.82 (6.50 to 17.14)	<0.001	15.59 (7.52 to 23.66)	<0.001
Wind and frequency	3.34 (–1.98 to 8.66)	0.218‡	5.12 (–3.50 to 13.73)	0.243‡
Nausea and vomiting	4.97 (1.53 to 8.41)	0.005	7.32 (2.04 to 12.60)	0.007
Activity limitation	5.97 (2.03 to 9.91)	0.003	8.27 (2.03 to 14.52)	0.010
Constipation and swallowing	2.54 (–2.09 to 7.18)	0.281‡	4.11 (–3.40 to 11.62)	0.282‡
SF-36 scores (norm based):				
Physical functioning	2.01 (–0.26 to 4.28)	0.082‡	3.35 (–0.33 to 7.03)	0.074‡
Role physical	0.57 (–2.10 to 3.24)	0.674‡	1.14 (–3.20 to 5.47)	0.606‡
Bodily pain	1.52 (–0.90 to 3.94)	0.218‡	1.65 (–2.25 to 5.54)	0.406‡
General health	2.76 (0.21 to 5.31)	0.034	3.79 (–0.29 to 7.88)	0.068‡
Vitality	0.37 (–2.23 to 2.98)	0.777‡	0.19 (–4.03 to 4.41)	0.928‡
Social functioning	1.72 (–1.05 to 4.49)	0.221‡	2.36 (–2.13 to 6.84)	0.301‡
Role emotional	2.67 (0.07 to 5.27)	0.044	4.56 (0.34 to 8.79)	0.034
Mental health	0.59 (–1.96 to 3.14)	0.650‡	0.40 (–3.72 to 4.51)	0.849‡
EQ-5D score	0.047 (–0.013 to 0.108)	0.126‡	0.069 (–0.029 to 0.167)	0.168‡

*Difference is surgery group minus medical group. Analyses adjusted for body mass index, age, sex, baseline score, and baseline-group interaction unless stated otherwise.

†REFLUX questionnaire a disease-specific measure of quality of life (score range 0–100).

‡Adjusted for body mass index, age, sex, and baseline score.

Figures

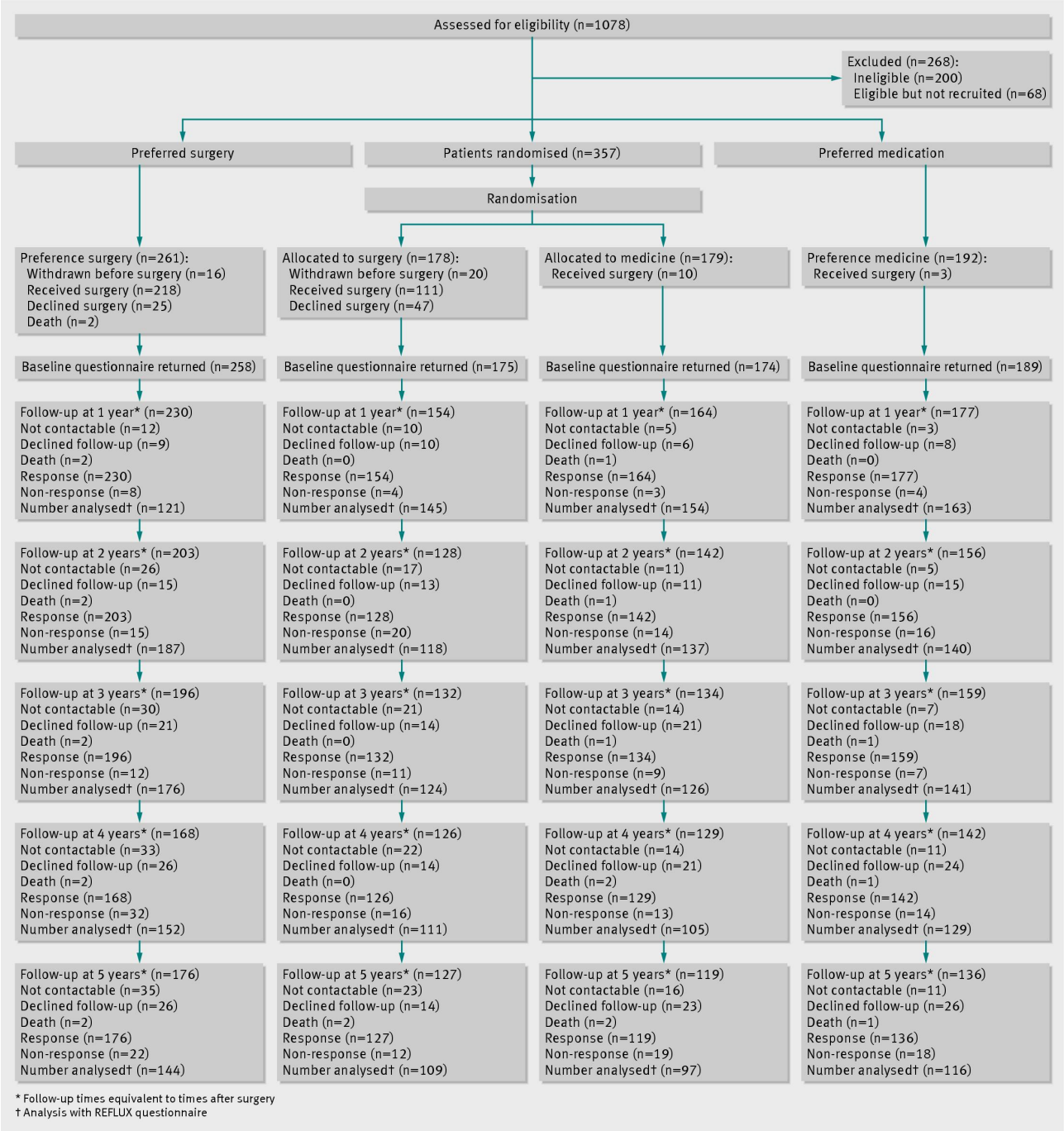

Fig 1 Consort diagram of flow of participants through study

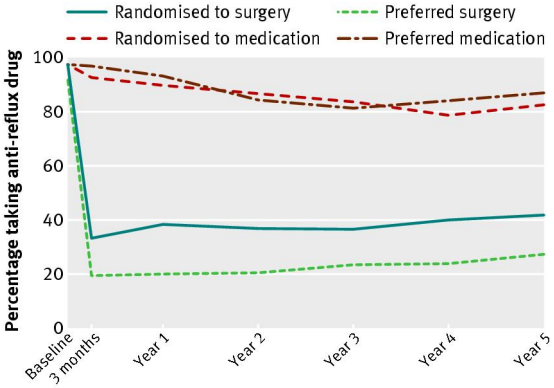

Fig 2 Use of any antireflux drugs at baseline and at follow-up among participants with chronic gastro-oesophageal reflux disease who were randomised to or selected surgical or medical treatment

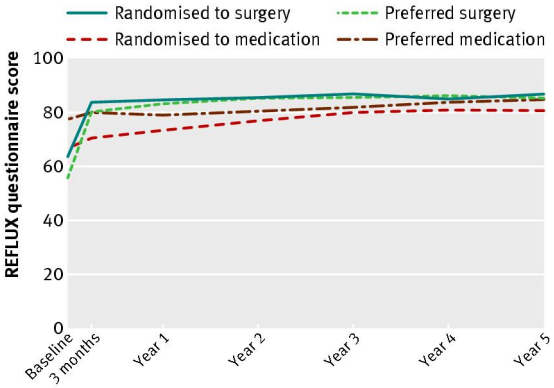

Fig 3 Mean REFLUX questionnaire score at baseline and at follow-up points among participants with chronic gastro-oesophageal reflux disease who were randomised to or selected surgical or medical treatment. Scores range 0–100, the higher the score the better the participant felt