

Video-assisted anal fistula treatment versus fistulectomy and sphincter repair in the treatment of high cryptoglandular anal fistula: a randomized clinical study

Karam M. Sørensen^{1,2*}, Sören Möller^{3,4} and Niels Qvist^{1,2}

¹Department of Surgery, Research Unit for Surgery and IBD Care, Odense University Hospital, Odense, Denmark

²University of Southern Denmark, Odense, Denmark

³OPEN – Open Patient data Explorative Network, Odense University Hospital, Odense, Denmark

⁴Department of Clinical Research, University of Southern Denmark, Odense, Denmark

*Correspondence to: Research Unit for Surgery and IBD Care, Odense University Hospital, J.B. Winsløvs Vej 4, 5000 Odense C, Denmark (e-mail: karam.faiq.sorensen@rsyd.dk)

Abstract

Background: Video-assisted anal fistula treatment (VAAFT) may have a recurrence rate comparable to that of fistulectomy and sphincter repair (FSR) in the treatment of high anal fistula and with potential advantages in wound healing, functional outcome and quality of life. The aim and objectives of the study are to compare the outcome of VAAFT with that of FSR for high cryptoglandular anal fistula.

Methods: This was a single-centre randomized controlled trial of adults with high anal fistula comparing FSR with VAAFT. Primary outcome was fistula recurrence. Secondary outcomes were results of anal manometry, quality of life and faecal continence. A power calculation of 33 patients in each arm (1:1) was based on recurrence in the FSR and VAAFT groups of 5 per cent and 30 per cent respectively. Follow-up at 6 months after surgery included physical examination, MRI, anal manometry, quality-of-life assessment (RAND SF 36 questionnaire) and faecal-continence assessment (Wexner score).

Results: The study was terminated early due to high recurrence rates in both groups. A total of 45 patients were included. Recurrence rates were 65 per cent for VAAFT and 27 per cent for FSR, with hazard ratio 4.18 ($P = 0.016$). Length of the fistula was a risk factor with an association with recurrence (hazard ratio 1.8, $P = 0.020$). There were significant differences in quality of life in favour of FSR and in anal manometry in favour of VAAFT with a significant improvement in Wexner score in both groups.

Conclusion: FSR was associated with a lower recurrence rate than VAAFT in the management of complex anal fistulae in this single-centre study but the study was terminated early due to higher than predicted recurrence rate in both groups.

Registration number: NCT02585167 (<http://www.clinicaltrials.org>).

Introduction

About one-fifth of anal fistulae are classified as complex, including trans-sphincteric or high fistulae¹. Fistulectomy and primary sphincter repair (FSR) has been described as an effective treatment for complex anal fistula, with success rates of more than 90 per cent in non-randomized studies^{2–4}. This method carries the risk of delayed wound healing and impaired faecal continence in more than 20 per cent^{3,5–7}. Anal fistula surgery involving the sphincter reduces anal canal pressure resulting in impaired anal continence⁸. The results of quality-of-life measurements and functional studies after anal sphincter surgery are contradictory^{7–12}.

An alternative to FSR may be the minimally invasive sphincter-preserving procedure, video-assisted anal fistula treatment (VAAFT)¹³. Prospective studies have demonstrated promising results^{13–18} with low recurrence rates of 12.5–17 per cent and success rates after long-term (2–3 years) follow-up between 70 and 85 per cent^{19–22}, although these figures include reoperation. The VAAFT method has the advantage of direct visualization of the

fistula tract allowing identification of secondary tracts and cavities, sphincter preservation and potentially reduced postoperative discomfort. The recurrence rate of the fistula is higher when VAAFT is used to treat complex trans-sphincteric fistulas²³.

The aim of the present study was to compare the outcome of VAAFT (intervention) with FSR (control) in the treatment of high anal fistula.

Methods

This study was performed as a randomized controlled open-label trial to compare the outcome of treatment of complex cryptoglandular anal fistula by VAAFT (minimally invasive) with treatment by FSR. The study was reported in accordance with the CONSORT statement²⁴ (Table S1) and conducted at the surgical department, Odense University Hospital, between February 2016 and May 2021. K.M.S. received basic and advanced training for the VAAFT procedure and performed several procedures prior to

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the study initiation. All allocated procedures were performed by K.M.S.

The primary objective was to compare recurrence after initial treatment at 6-month follow-up. The secondary objectives (at 6-month follow-up) were time to wound healing (defined as an epithelialized wound), faecal continence evaluated with Wexner faecal-incontinence score²⁵, along with changes in anal manometry (changes in maximal resting and squeeze pressures) and quality of life measured with Rand Short Form (SF36)²⁶.

Eligible patients were adults (18 years and older) referred to Odense University Hospital surgical department with complex cryptoglandular anal fistula, with intention of surgical treatment. High anal fistula, involving more than one-third of the external anal sphincter, was considered to be of the complex type according to the current Danish guidelines²⁷ (based on the original Parks' classification of anal fistula). Exclusion criteria were Crohn's disease, signs of suppuration and cavitation, immunosuppressive treatment, malignancy within the last 5 years, previous pelvic radiotherapy and a rectovaginal fistula.

After informed consent, patients were randomly allocated into intervention (VAAFT) or control (FSR), using REDCap electronic data-capture tools hosted at OPEN (Open Patient data Explorative Network)^{28,29}. K.M.S. was responsible for patient assessment for eligibility, inclusion and preoperative randomization.

All included patients had undergone anal examination under general anaesthesia to ensure the anatomical classification of the fistula and adequate drainage by a loose seton suture. All patients underwent endoanal ultrasonography to exclude undetected cavitation and suppuration as well as defects in the anal sphincter complex. All had the fistula adequately drained by a loose seton suture for at least 3 months prior the allocated treatment. Preoperative baseline MRI scanning of the anal canal was performed and colonoscopy was performed when indicated. Preoperative baseline measurement of faecal incontinence and quality of life using the Wexner faecal-incontinence score and Rand SF-36 score, respectively, were performed in all included patients, as well as baseline anal manometry using the MANOSCANTM AR high-resolution anorectal manometry system (Medtronic, Minneapolis, USA). All allocated procedures were carried out as day-case surgery, with preoperative bowel preparation (Bisacodyl) and broad-spectrum antibiotics (single intravenous doses of metronidazole and cefuroxime). Perioperative endoluminal ultrasonography was repeated prior to allocated treatment to ensure fistula classification. All excised fistula tissue was sent for histopathology.

In the FSR group, the fistula tract was excised in its entire length after dividing the involved part of the anal sphincter. The sphincter complex including the anal canal was reconstructed using interrupted absorbable sutures. The internal and external anal sphincters were repaired separately. The lateral part of the incision was left open for drainage.

In the VAAFT group, the procedure was performed according to the original technique described by Meinerio and Mori¹³, using a Meinerio fistuloscope (Karl-Storz, Tuttlingen, Germany). The internal orifice was secured with two-layer closure using interrupted absorbable sutures for both the muscle and anal mucosa layers. The external orifice was excised leaving the wound for secondary healing.

The standard postoperative regimen was analgesia, oral broad-spectrum antibiotics (ciprofloxacin and metronidazole) for 5 days, oral laxative (magnesium oxide) for 14 days and patients were instructed to avoid heavy physical straining for at least 4 weeks after operation. The wounds were kept clean by repeated washing and no dressing was used.

Included patients were assigned to a scheduled clinical follow-up at 6 months after treatment, which included clinical wound assessment for healing and signs of persistent fistula by physical examination and endoanal ultrasonography. Patients were asked to fill out the Rand SF-36 questionnaire and Wexner faecal-incontinence score. MRI scanning of the anal canal, endoanal ultrasonography and high-resolution anorectal manometry were performed.

Whenever there was a suspicion of recurrence or fistula formation, examination under general anaesthesia was performed. A recurrence was treated by FSR irrespective of the primary treatment.

Data collection

At inclusion, baseline data were registered, including patients' demography (age, gender, height and weight), co-morbidities (diabetes, cardiovascular, lung, renal and immune or connective-tissue disease), smoking habit (smoker, quit, never) and alcohol consumption (0, 7 (women) or 14 (men) or fewer units/week, more than 7 (women) or 14 (men) units/week). Duration of symptoms and location of the fistula were also recorded. No occupational data were collected. Operative data included length and location of the fistula (anterior or posterior) and anorectal manometric measurement, including maximal resting pressure and maximal squeezing pressure.

Clinical follow-up data included visual evaluation of wound healing (healed, with scar or hypergranulation formation or visible discharge) and recurrence of fistula. Radiological follow-up data of fistula recurrence and presence of a sphincter defect were obtained by endoanal ultrasonography and MRI scanning. Quality-of-life, faecal-incontinence and manometric data were recorded at 6 months after the allocated surgery.

The following factors were examined in the analysis as risk factors for fistula recurrence: age, gender, BMI, tobacco and alcohol use, duration of symptoms, health status, allocated treatment, length of fistula in centimetres and fistula location.

Statistical analysis

Desired sample size was determined for comparison of two proportions, assuming a rate of recurrence of 5 per cent in the FSR group and 30 per cent in the VAAFT group, resulting in a necessary sample size of 33 patients in each group of the study for obtaining a significance level of 5 per cent at a power of 80 per cent. The assumed fistula recurrence rates for FSR and VAAFT were assigned to ensure a 25 per cent difference in the fistula recurrence between the two groups, and the high recurrence rate accepted for VAAFT was mainly due to the minimally invasive nature of VAAFT compared with FSR treatment with previously reported low recurrence rates.

Differences in recurrence of the fistula were analysed using survival models applying the Kaplan–Meier method. Cox proportional hazards regression was performed to obtain hazard ratios with 95 per cent confidence intervals for recurrence with respect to the intervention, and was applied both as univariable and multivariable analysis for risk factors (age, gender, BMI, tobacco and alcohol use, duration of symptoms, health status, allocated treatment, length of fistula and fistula location). The Nelson–Aalen estimator was applied to obtain cumulative hazard rates for recurrence. The eight parameters of Rand SF-36 questionnaire, anorectal manometric measurements and Wexner faecal-incontinence score were compared between groups using Mann–Whitney *U*-test and *t*-test when appropriate. Demographic co-variables were compared using two-sample Wilcoxon rank sum

(Mann–Whitney) test and Pearson χ^2 test when appropriate. P values below 0.050 were considered statistically significant. Stata corporation © (StataCorp LLC, Texas, USA) software, version 16.1, was used.

The study protocol did not initially include an interim analysis, but as it was an unblinded study, high recurrence rates were observed in the intervention group (VAAFT). Therefore, the study group was obliged to undertake an early analysis resulting in early termination of the study.

Ethical considerations

Participation was voluntary. Patients could withdraw their consent at any time and they received no remuneration. Data collection and processing were performed according to the Act of Processing of Personal Data and Health Act. The project was approved by the local Research Ethics Committee (S-20150053) and by Region of Southern Denmark's joint review of the Data Protection Agency (20/18031). The trial was registered on Clinicaltrial.org (identification number NCT02585167).

Results

During the study period, a total of 536 patients were referred for the assessment of a complex anal fistula of whom 64 had a high trans-sphincteric anal fistula and were assessed for eligibility. Forty-seven patients were included (17 patients declined to take part). Two patients were excluded (one withdrawal, one with excessive suppuration at time of operation), leaving 45 patients for analysis with 23 patients allocated in the VAAFT group and 22 patients in the FSR group (Fig. 1).

Table 1 shows the distribution of the demographic characteristics in the two groups. Male to female ratio was 2.5:1 and mean age was 43.8 (range 22–75) years. Groups were well matched for age and BMI and 37 patients were either in the overweight (BMI 25–29.9 kg/m²) or obese (BMI greater than 30 kg/m²) categories³⁰. None of the patients had a stoma. Mean length of the fistula tract was 4.3 cm, 19 fistulas were located posteriorly to the anus and mean duration of symptoms was 14.6 months, without major differences between the groups. Missing data included three follow-

up MRI scans and one follow-up anal-manometry measurement. Histopathological study of the fistula tissue was possible in 43 patients (96 per cent), and none showed inflammatory bowel disease. Only two patients, one in each group, had a previous history of anal fistula surgical treatment. Besides recurrences, there were no other medical or surgical complications and no patient needed a diverting stoma.

Recurrence of the fistula

Of the 45 patients analysed, 21 (47 per cent) had fistula recurrence: 15 (65 per cent) in the VAAFT group and six (27 per cent) in the FSR group ($P=0.016$). Recurrences occurred throughout the observation time in both groups (Fig. 2), and all were at the operation site. The estimated cumulative hazard of recurrence was 0.30 in the FSR group and 0.98 in VAAFT group at 6 months' follow-up.

Multivariable analysis demonstrated a significantly higher risk of recurrence following VAAFT with a hazard ratio 4.18 (95 per cent c.i. 1.30 to 13.42; $P=0.016$), and analysis of risk factors showed a significant association between length of the fistula and recurrence with hazard ratio 1.8 (95 per cent c.i. 1.097 to 2.984; $P=0.020$), while higher BMI was associated with lower risk of recurrence, hazard ratio 0.76 (95 per cent c.i. 0.633 to 0.910; $P=0.003$) and the obese category with hazard ratio 0.11 (95 per cent c.i. 0.019 to 0.618; $P=0.012$).

Clinically obscured recurrence was revealed by MR scanning at follow-up in six patients in the FSR group and four in the VAAFT group. At follow-up, three patients in the FSR group and 10 patients in the VAAFT group had not achieved wound healing (epithelialization) ($P=0.027$).

Faecal-incontinence score

The mean Wexner faecal-incontinence score at baseline was comparable between the two groups ($P=0.135$) with 36 per cent of the patients having mild or no symptoms of incontinence (Fig. 3). However, 18 patients in the VAAFT group had moderate incontinence at baseline compared with eight in the FSR group ($P=0.028$). There was a significant improvement in the mean Wexner faecal-incontinence score when comparing baseline and

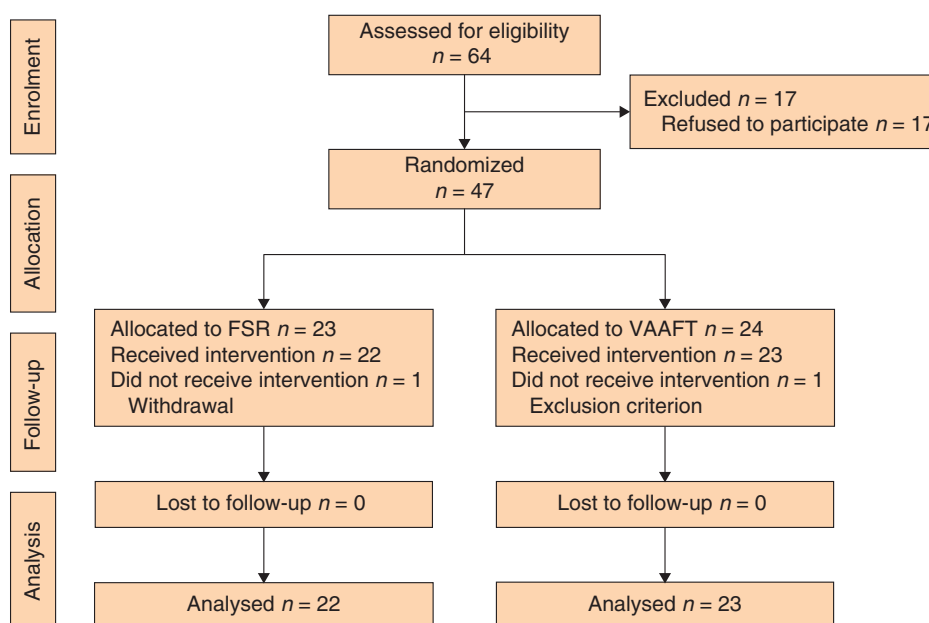


Fig. 1 CONSORT diagram

Table 1 Patient demographic characteristics

Variables	FSR (n = 22)	VAAFT (n = 23)	Total (n = 45)
Age (years)*	45.05 (38.93–51.16)	42.65 (37.17–48.14)	43.82 (39.88–47.77)
Young: 18–40 years	8 (36)	11 (48)	19 (42)
Old: > 40 years	14 (64)	12 (52)	26 (58)
Gender			
Male	15 (68)	17 (74)	32 (71)
Female	7 (32)	6 (26)	13 (29)
BMI (kg/m²)*	29.25 (27.56–30.95)	28.07 (26.21–29.92)	28.65 (27.43–29.87)
Normal weight	1 (5)	7 (30)	8 (18)
Overweight	13 (59)	8 (35)	21 (47)
Obese	8 (36)	8 (35)	16 (36)
Tobacco			
None	9 (41)	16 (70)	25 (56)
Smoker	7 (32)	2 (9)	9 (20)
Quit	6 (27)	5 (22)	11 (24)
Alcohol			
0	2 (9)	2 (9)	4 (9)
≤7/14 unit/week	18 (82)	20 (87)	38 (84)
>7/14 unit/week	2 (9)	1 (4)	3 (7)
Health status			
Healthy	19 (86)	19 (83)	38 (84)
Co-morbidity	3 (14)	4 (17)	7 (16)
Duration (months)*	11.6 (8.11–15.16)	17 (12.38–22.40)	14.6 (11.47–17.67)
Fistula location			
Anterior	14 (64)	12 (52)	26 (58)
Posterior	8 (36)	11 (48)	19 (42)
Length of fistula (cm)*	4.41 (3.73–5.09)	4.24 (3.62–4.85)	4.32 (3.88–4.76)

Values in parentheses are percentages, unless indicated otherwise. *values are mean (95 per cent confidence intervals). 1 unit of alcohol is 12 g alcohol; maximal 7 units for females and 14 units for males per week as Danish health administrations recommendation for alcohol consumption. VAAFT, Video-assisted anal fistula treatment; FSR, fistulectomy and sphincter repair.

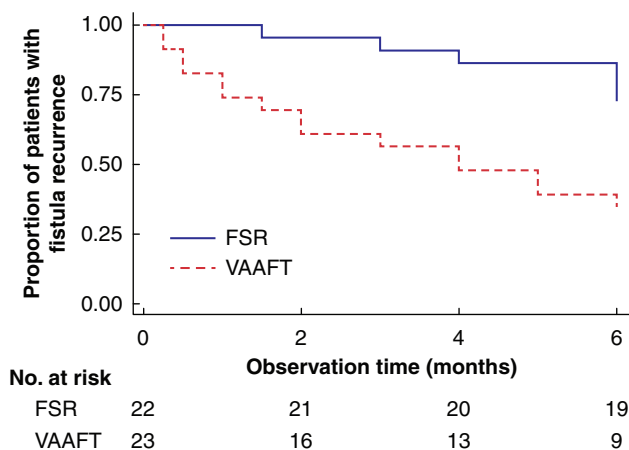


Fig. 2 Kaplan-Meier estimate of fistula recurrence

FSR, fistulectomy and sphincter repair; VAAFT, video-assisted anal fistula treatment (additional KM curve data available in Table S2).

follow-up measurements for both groups (FSR $P=0.022$ and VAAFT $P=0.011$). There was improvement in the continence in both groups without difference when stratifying the score into categorical variables (none, mild, moderate and severe incontinence).

Anal manometry

There were no differences between the groups in baseline measurements of maximum resting pressure and maximum squeezing pressure. A decrease in the mean resting and squeezing pressures was observed in both groups at follow-up but this was only statistically significant for the mean squeezing pressure in the FSR group ($P=0.018$). At follow-up, endoluminal ultrasonography revealed a

defect of the internal anal sphincter in nine (41 per cent) patients in the FSR group and one (4 per cent) in VAAFT group ($P=0.003$). The presence of a sphincter defect was unrelated to the results of anal manometry or faecal-incontinence score.

Quality-of-life score

Analysis of the means of the eight parameters of RAND SF-36 score (Table 2) revealed a significant increase (less disability) in all the parameters in the FSR group and in two parameters (physical function score and pain score) in the VAAFT group. Comparing the two groups at follow-up, significant differences were found in favour of the FSR group in three of the parameters (energy/fatigue score, social functioning score, pain score).

Early cessation of the study

It was necessary to perform an interim analysis of the results due to the observed higher recurrence rate in the intervention group throughout the study, which showed a significant statistical difference in the primary objective, which could not be altered by continuing the study (futility analysis). The study was terminated early on this basis³¹.

Discussion

This is the first reported randomized clinical trial on the outcome of surgical treatment of high cryptoglandular anal fistula with VAAFT compared with FSR. The recurrence rate of the fistula was significantly higher after VAAFT (65 per cent) compared with FSR (27 per cent). Only one of the risk factors investigated (length of the fistula) was significantly associated with fistula recurrence. The demographic characteristics of the study population were similar to those reported in previous studies^{1,2,5} with males being affected 2.5 times more than females and mean age in the fifth decade of life. In comparison with previous reports, about 58

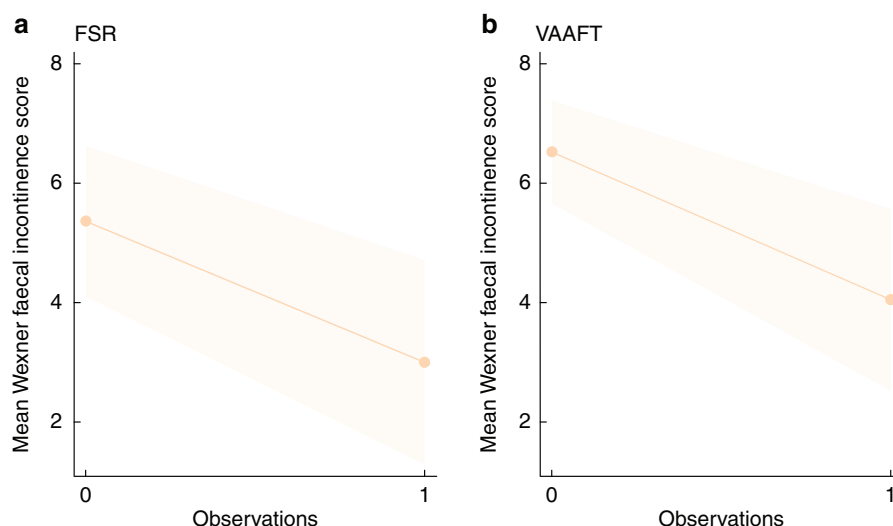


Fig. 3 Mean profile of differences in Wexner faecal-incontinence score over the observation period

a Fistulectomy and sphincter repair (FSR). **b** Video-assisted anal fistula treatment (VAAFT). Shaded areas are 95 per cent confidence intervals. 0, baseline; 1, follow-up.

Table 2 Quality of life measurements of study population

Rand SF-36	FSR			VAAFT			FSR and VAAFT			FSR versus VAAFT
	Baseline	Follow-up	P	Baseline	Follow-up	P	Baseline	Follow-up	P	P
Physical function score	81.36	94.32	0.002	74.78	85.65	0.002	78	89.89	<0.001	0.063
Role limitations due to physical health score	62.12	86.36	0.017	65.21	68.12	0.775	63.70	77.04	0.063	0.116
Role limitations due to emotional problems score	62.12	86.36	0.017	65.22	68.12	0.775	63.70	77.04	0.063	0.116
Energy/fatigue score	53.18	75.90	0.001	49.34	59.13	0.050	51.22	67.33	<0.001	0.012
Emotional well-being score	70	82.54	0.004	67.36	74.26	0.052	68.62	78.31	0.001	0.132
Social functioning score	81.25	93.18	0.050	65.22	75	0.065	73.06	83.89	0.006	0.012
Pain score	68.07	88.64	<0.001	57.83	73.91	0.002	62.83	81.11	<0.001	0.017
General health score	69.77	79.55	0.005	67.17	69.57	0.410	68.44	74.44	0.008	0.077

Values are the mean of each score of the eight parameters of Rand SF 36. The eight parameters of Rand SF-36 questionnaire were compared between groups using Mann-Whitney U-test and t-test when appropriate. FSR, fistulectomy and sphincter repair; VAAFT, video-assisted anal fistula treatment.

per cent of the fistulae were located anteriorly to the anus. The patients were included according to clearly defined inclusion criteria and selection bias cannot be rejected or confirmed.

The recurrence rate after FSR was previously reported to be between 1 and 13 per cent in non-randomized trials²⁻⁴. The recurrence rate after FSR in the present study was higher and might be explained by inclusion of only patients with high fistula and that the previously reported recurrence rates included results from reoperations. The recurrence of fistula after VAAFT was considerably higher (65 per cent) in this study compared with that in previously reported studies, which also included patients with non-complex fistulas. High recurrence rate was previously reported after VAAFT for high trans-sphincteric anal fistula²³. Recurrences occurred at the operation site. MRI scanning was not performed in patients with recurrent fistula. Therefore, it is not certain whether the recurrences were missed secondary tracts or original fistulas. It is more likely that that recurrence was at the site of the original tract in the VAAFT group. There were no serious surgical complications (Clavien-Dindo grade III or above) observed in any patients and there was no need for a diverting stoma.

Impairment of faecal continence following both treatments was not demonstrated in this study. Despite the decrease in pressure measurements by anal manometry, this was not reflected in continence as evaluated by the Wexner score. There was a significant improvement in Wexner score in both groups, without the predicted advantage for the VAAFT group. The presence of an anal-sphincter defect and the size of the defect along with mean squeeze pressure were previously found to correlate to faecal-incontinence score³², but the presence of a defect in the internal anal sphincter at follow-up in the present study did not significantly affect the results of anal manometry or faecal-incontinence score and might be explained by different study populations.

VAAFT was previously reported to be associated with improvement in quality of life¹⁴. Despite the minimally invasive nature of VAAFT, this study demonstrated that improvement in quality-of-life measurements was in favour of FSR. This might be due to the significantly higher recurrence rate and delayed wound healing in the VAAFT group.

The early cessation of the study was due to the significantly higher rate of recurrence in the VAAFT group³¹. Although the

surgical procedures were all performed by a dedicated fistula surgeon (K.M.S.) with the necessary training in both procedures, the learning curve might be a confounder. Another limitation of the study is it being a low-volume single-centre study with inherent lack of external validity. The study was also underpowered as the desired sample calculation was focused on having 25 per cent difference between the groups with a low recurrence rate for FSR. The fistula-recurrence rate was higher than predicted in both groups.

This randomized study for high cryptoglandular anal fistula required early cessation due to a significantly higher recurrence rate after VAAFT compared with FSR.

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Disclosure. The authors declare no conflict of interest.

Supplementary material

[Supplementary material](#) is available at *BJS Open* online.

References

- Barwood N, Clarke G, Levitt S, Levitt M. Fistula-in-ano: a prospective study of 107 patients. *Aust N Z J Surg* 1997;**67**:98–102.
- Roig JV, Garcia-Armengol J, Jordan JC, Alos R, Solana A. Immediate reconstruction of the anal sphincter after fistulectomy in the management of complex anal fistulas. *Colorectal Dis* 1999;**1**:137–140.
- Seyfried S, Bussen D, Joos A, Galata C, Weiss C, Herold A. Fistulectomy with primary sphincter reconstruction. *Int J Colorectal Dis* 2018;**33**:911–918.
- Farag AFA, Elbarmelgi MY, Mostafa M, Mashhour AN. One stage fistulectomy for high anal fistula with reconstruction of anal sphincter without fecal diversion. *Asian J Surg* 2019;**42**:792–796.
- Roig JV, Garcia-Armengol J, Jordan JC, Moro D, Garcia-Granero E, Alos R. Fistulectomy and sphincteric reconstruction for complex cryptoglandular fistulas. *Colorectal Dis* 2010;**12**:e145–e152.
- Litta F, Parello A, De Simone V, Grossi U, Orefice R, Ratto C. Fistulotomy and primary sphincteroplasty for anal fistula: long-term data on continence and patient satisfaction. *Tech Coloproctol* 2019;**23**:993–1001.
- Bokhari S, Lindsey I. Incontinence following sphincter division for treatment of anal fistula. *Colorectal Dis* 2010;**12**:e135–e139.
- Roig JV, Jordan J, Garcia-Armengol J, Esclapez P, Solana A. Changes in anorectal morphologic and functional parameters after fistula-in-ano surgery. *Dis Colon Rectum* 2009;**52**:1462–1469.
- Sailer M, Bussen D, Fuchs KH, Thiede A. [Quality of life of patients with fecal incontinence]. *Langenbecks Arch Chir Suppl Kongressbd* 1998;**115**:973–975.
- Perez F, Arroyo A, Serrano P, Sanchez A, Candela F, Perez MT et al. Randomized clinical and manometric study of advancement flap versus fistulotomy with sphincter reconstruction in the management of complex fistula-in-ano. *Am J Surg* 2006;**192**:34–40.
- Grucela A, Gurland B, Kiran RP. Functional outcomes and quality of life after anorectal surgery. *Am Surg* 2012;**78**:952–956.
- Visscher AP, Schuur D, Roos R, Van der Mijnsbrugge GJ, Meijerink WJ, Felt-Bersma RJ. Long-term follow-up after surgery for simple and complex cryptoglandular fistulas: fecal incontinence and impact on quality of life. *Dis Colon Rectum* 2015;**58**:533–539.
- Meinero P, Mori L. Video-assisted anal fistula treatment (VAAFT): a novel sphincter-saving procedure for treating complex anal fistulas. *Tech Coloproctol* 2011;**15**:417–422.
- Jiang HH, Liu HL, Li Z, Xiao YH, Li AJ, Chang Y et al. Video-assisted anal fistula treatment (VAAFT) for complex anal fistula: a preliminary evaluation in China. *Med Sci Monit* 2017;**23**:2065–2071.
- Seow-En I, Seow-Choen F, Koh PK. An experience with video-assisted anal fistula treatment (VAAFT) with new insights into the treatment of anal fistulae. *Tech Coloproctol* 2016;**20**:389–393.
- Wałęga P, Romaniszyn M, Nowak W. VAAFT: a new minimally invasive method in the diagnostics and treatment of anal fistulas—initial results. *Pol Przegl Chir* 2014;**86**:7–10.
- Mendes CR, Ferreira LS, Sapucaia RA, Lima MA, Araujo SE. Video-assisted anal fistula treatment: technical considerations and preliminary results of the first Brazilian experience. *Arq Bras Cir Dig* 2014;**27**:77–81.
- Kochhar G, Saha S, Andley M, Kumar A, Saurabh G, Pusuluri R et al. Video-assisted anal fistula treatment. *JLS* 2014;**18**:e2014.00127.
- Meinero P, Mori L, Gasloli G. Video-assisted anal fistula treatment: a new concept of treating anal fistulas. *Dis Colon Rectum* 2014;**57**:354–359.
- Zelic M, Karlovic D, Krsul D, Bacic D, Warusavitarne J. Video-assisted anal fistula treatment for treatment of complex cryptoglandular anal fistulas with 2 years follow-up period: our experience. *J Laparoendosc Adv Surg Tech A* 2020;**30**:1329–1333.
- Regusci L, Fasolini F, Meinero P, Caccia G, Ruggeri G, Serati M et al. Video-assisted anal fistula treatment (VAAFT) for complex anorectal fistula: efficacy and risk factors for failure at 3-year follow-up. *Tech Coloproctol* 2020;**24**:741–746.
- Giarratano G, Shalaby M, Toscana C, Sileri P. Video-assisted anal fistula treatment for complex anal fistula: a long-term follow-up study. *Colorectal Dis* 2020;**22**:939–944.
- Romaniszyn M, Walega P. Video-assisted anal fistula treatment: pros and cons of this minimally invasive method for treatment of perianal fistulas. *Gastroenterol Res Pract* 2017;**2017**:9518310.
- Schulz KF, Altman DG, Moher D; CONSORT Group. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *Trials* 2010;**11**:32.
- Jorge JM, Wexner SD. Etiology and management of fecal incontinence. *Dis Colon Rectum* 1993;**36**:77–97.
- Bjorner JB, Thunedborg K, Kristensen TS, Modvig J, Bech P. The Danish SF-36 Health Survey: translation and preliminary validity studies. *J Clin Epidemiol* 1998;**51**:991–999.
- Lundby L, Hagen K, Christensen P, Buntzen S, Thorlacius-Ussing O, Andersen J et al. Treatment of non-IBD anal fistula. *Dan Med J* 2015;**62**:C5088.
- Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L et al.; REDCap Consortium. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform* 2019;**95**:103208.
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) – a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;**42**:377–381.

30. World Health Organization. *253 Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation*. Geneva: World Health Organization, 2000, xii.
31. Deichmann RE, Krousel-Wood M, Breault J. Bioethics in practice: considerations for stopping a clinical trial early. *Ochsner J* 2016; **16**:197–198.
32. Bjorsum-Meyer T, Christensen P, Jakobsen MS, Baatrup G, Qvist N. Correlation of anorectal manometry measures to severity of fecal incontinence in patients with anorectal malformations—a cross-sectional study. *Sci Rep* 2020;**10**:6016.