



# Comparison of Preoperative and Postoperative MRI After Fistula-in-Ano Surgery: Lessons Learnt from An Audit of 1323 MRI At a Single Centre

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## Abstract

**Aim** Several studies have evaluated the efficacy of preoperative MRI in fistula-in-ano. However, the evaluation of MRI after fistula-in-ano surgery has never been done. The aim was to evaluate the utility of MRI in postoperative period after fistula-in-ano surgery.

**Methods** Preoperative MRI was done in all the patients presenting with fistula-in-ano. Postoperative MRI was done to check radiological healing in clinically healed fistulas or when postoperative complication/healing problem was seen. The postoperative MRI was compared with preoperative MRI and correlated with the clinical picture.

**Results** A total of 1323 MRI were done in 1003 fistula-in-ano patients, out of which 702 patients underwent surgery. In 702 patients, there were 361 recurrent fistulas, 153 had associated abscess, 388 had multiple tracts, 146 had horseshoe tract, and 76 had supralelevator fistula. In total, 320 postoperative MRI scans were done in 180/702 patients. The requirement of postoperative MRI was significantly higher in complex (grades III–V) than simple fistulas (grades I–II) [43.5% (136/313) vs. 11.3% (44/389), respectively,  $P < 0.0001$ ]. In early postoperative period (8 weeks), healing (granulation) tissue was difficult to differentiate from active fistula tract/pus. The complete radiological healing took at least 10–12 weeks. So getting MRI scan for the assessment of healing was more accurate after 12 weeks. MRI was very accurate to identify postoperative complications like abscess, missed tract or non-healing of a tract. MRI detected such complications even in apparently clinically healed tracts. Closure/healing of internal opening and intersphincteric tract was assessed accurately by MRI and correlated well with the fistula healing.

**Conclusions** MRI is highly useful to assess healing and detect complications after fistula surgery.

## Introduction

MRI is the diagnostic modality of choice and the gold standard to assess and analyse fistula-in-ano [1]. Several studies done in the last two decades have shown immense benefits of doing MRI before fistula-in-ano surgery [1–3]. However, there has not been any study done in which MRI has been utilized to assess the fistula in the postoperative period. Assessing MRI done in the postoperative can be challenging as the postoperative changes can alter the tissue signals and make the interpretation difficult. In the paucity of any published data as how to interpret the postoperative MRI scans, the indication, utility and the

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evaluation of doing MRI scans after fistula-in-ano surgery (postoperative period) are practically unknown.

The purpose of this study was to compare the preoperative and postoperative MRI scans after fistula-in-ano surgery and to evaluate the value of MRI in assessing postoperative healing and complications after fistula-in-ano surgery.

## Methods

All the patients suffering from fistula-in-ano who reported to a specialized fistula treatment centre were thoroughly examined. Preoperative MRI was done in all the patients as per the protocol of the treatment centre [1, 4–7]. Recent study done in a large number of patients highlighted that after doing MRI, more than one-third of simple looking fistula (on history and examination) turned out to be a complex fistula [1]. In already known complex fistula (on history and examination), MRI added significant information in more than half of the patients, which changed the surgical approach in them [1]. Therefore, MRI had the potential to prevent a recurrence due to which it proved more economical in the long term. Moreover, the centre where the study was conducted was a referral centre for fistula-in-ano patients, and MRI was done in every fistula patient as a protocol. After surgery, the patients were regularly followed up. Postoperative MRI was done to check the radiological healing in the patients in whom the fistula seemed to have healed clinically or when some postoperative complication/problem with healing happened. The postoperative MRI was compared with the preoperative MRI and also correlated with the clinical picture.

After taking a detailed history, a thorough physical examination was done which included a rectal examination and a proctoscopic examination in the surgeon's office. The details were noted down in an excel sheet proforma. No attempt was done to probe the fistula tract or to inject any kind of contrast in the fistula tract (to conduct a sinogram). After this, an MRI scan was done. The MRI was studied in detail by an experienced radiologist who had 19 years of extensive experience of reading fistula-in-ano MRI scans and by the operating surgeon (author) who had 10 years of experience in analysing the fistula MRI. After independently analysing the MRI scans, both the radiologist and the surgeon made separate schematic diagrams of the fistula. Subsequently, the MRI was discussed by both the professionals and a consensus was reached. The location of internal opening, number and location of fistula tracts, number and position of external openings, presence of an associated abscess, a horseshoe tract, an intersphincteric component or a supralelevator extension was noted (Figs. 1, 2, 3, 4, 5, 6, 7 and 8).

Intraoperatively, a detailed patient examination was done after the induction of anaesthesia. Povidine iodine solution was gently injected from the external opening to see its egress inside the anorectum so as to accurately localize the internal opening. The location of the tracts and other associated parameters like abscess, horseshoe tract or supralelevator extension were carefully assessed and taken note of. Any discrepancies between the MRI findings and the intraoperative findings were also noted. After the completion of surgery, a final schematic diagram (Figs. 1, 2, 3, 4, 5 and 6) was made based on the clinical examination, the MRI findings and the intraoperative findings.

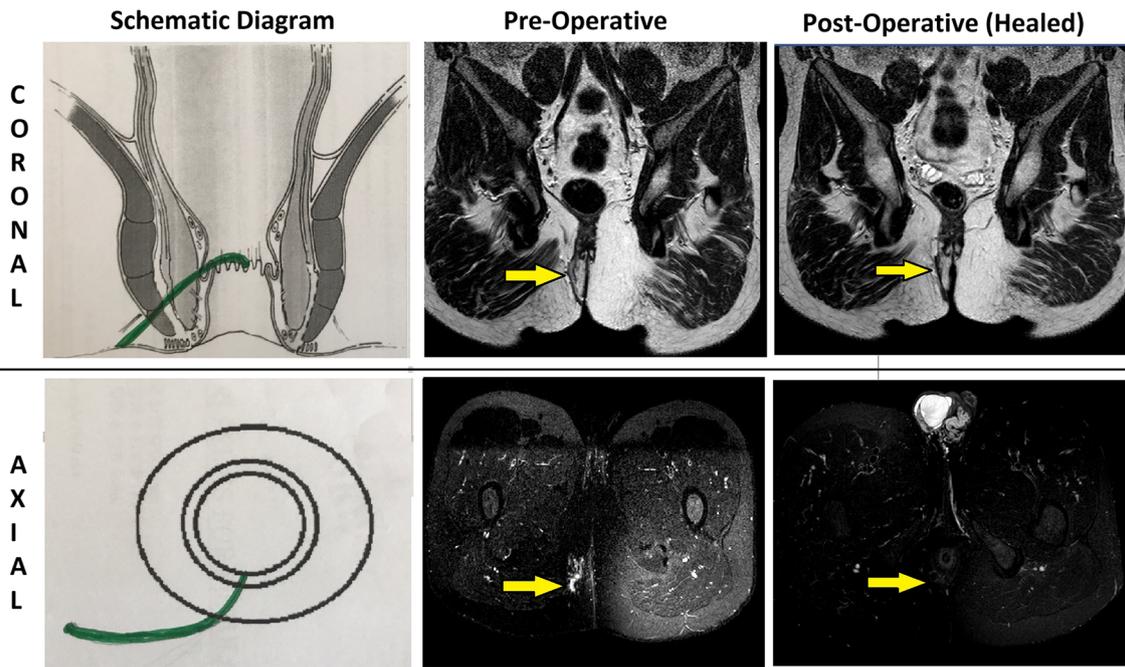
In the postoperative period, the patients were followed regularly. The MRI was repeated in the postoperative period in the following patients:

1. The healing did not occur as per the expected course
2. A complication happened or
3. The patient was keen to get a confirmation of the fistula healing. This may not be required in usual circumstances, but in the present study, many patients were referred patients with recurrent refractory fistula (> 50%) who had undergone several operations for the disease. Therefore, the proportion of patients getting MRI for this reason was also significant in this study.

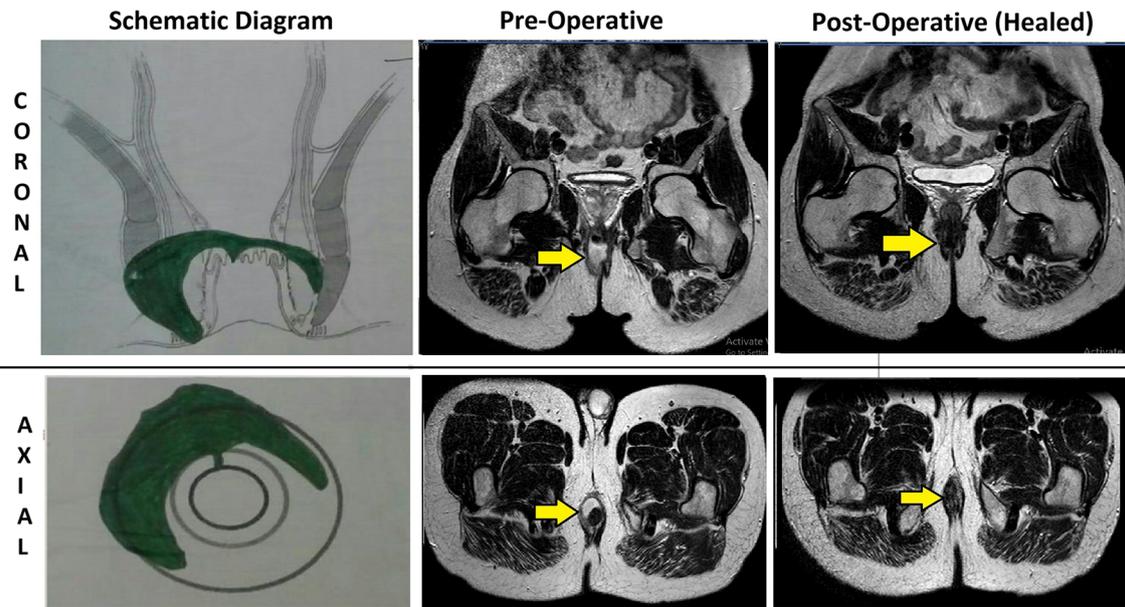
The approval for the study was taken from the ethical committee of the hospital, Indus Hospital Ethics Committee. The consent was taken from the patient for the preoperative as well as the postoperative MRI scan. The patient was duly informed about the role of MRI as well as the accuracy of MRI in perianal fistulas.

The postoperative MRI was compared with the preoperative MRI scan and also correlated with the clinical picture. The findings were noted in the pro forma. The patients were then followed up. In case the clinical outcome on follow-up differed from the noted outcome after MRI assessment, the difference in the outcome was discussed and the reason for the discrepancy was analysed. Due to paucity of data on postoperative MRI, the endeavour was to learn from every mistake as well as the correct assessment.

The fistulas were classified as per St James university hospital (SJUH) [8], Parks [9] and Garg [7] classifications (Table 1). Out of these classifications, Garg classification was used and the patients were categorized as simple and complex fistulas as per this classification [5, 7, 10]. Garg classification was a newer classification described in 2017. It was a significant improvement over the previously described Parks and St James University Hospital classifications [7–10]. Unlike Parks and St James University Hospital classifications, which did not correlate well with either severity or prognosis of the disease, Garg classification correlated quite well with both the severity and



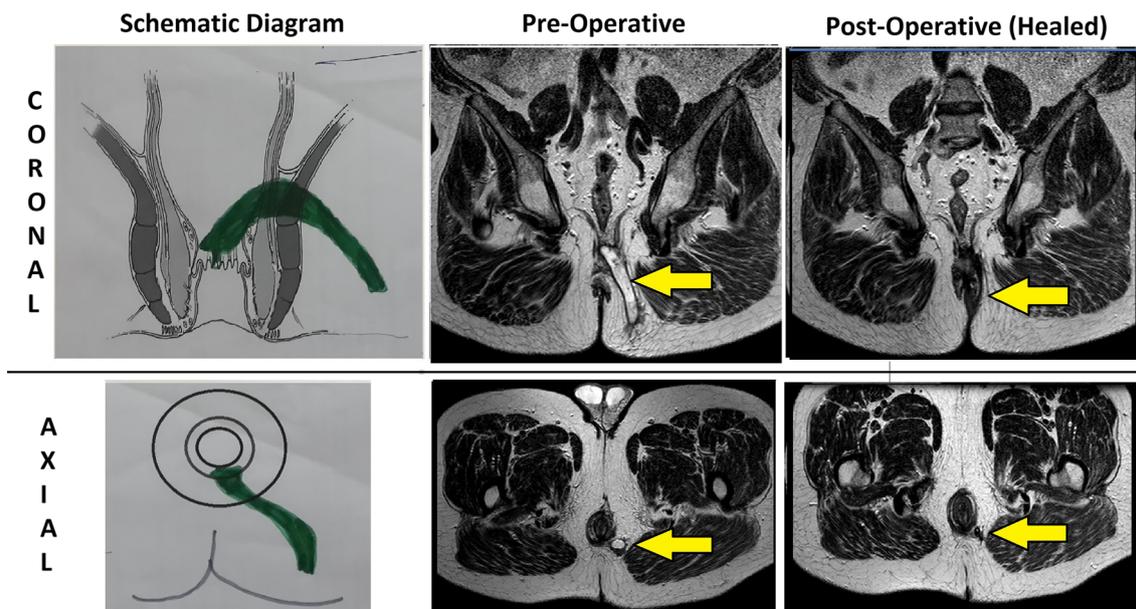
**Fig. 1** Grade I (Garg classification) fistula—low transsphincteric with a single tract in a 49-year-old male patient. Left panels—schematic diagrams, middle panels—preoperative MRI showing fistula tract (hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)



**Fig. 2** Grade II (Garg) fistula—low intersphincteric horseshoe abscess in a 45-year-old male patient. Left panels—schematic diagrams, middle panels—preoperative MRI showing fistula tract (hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)

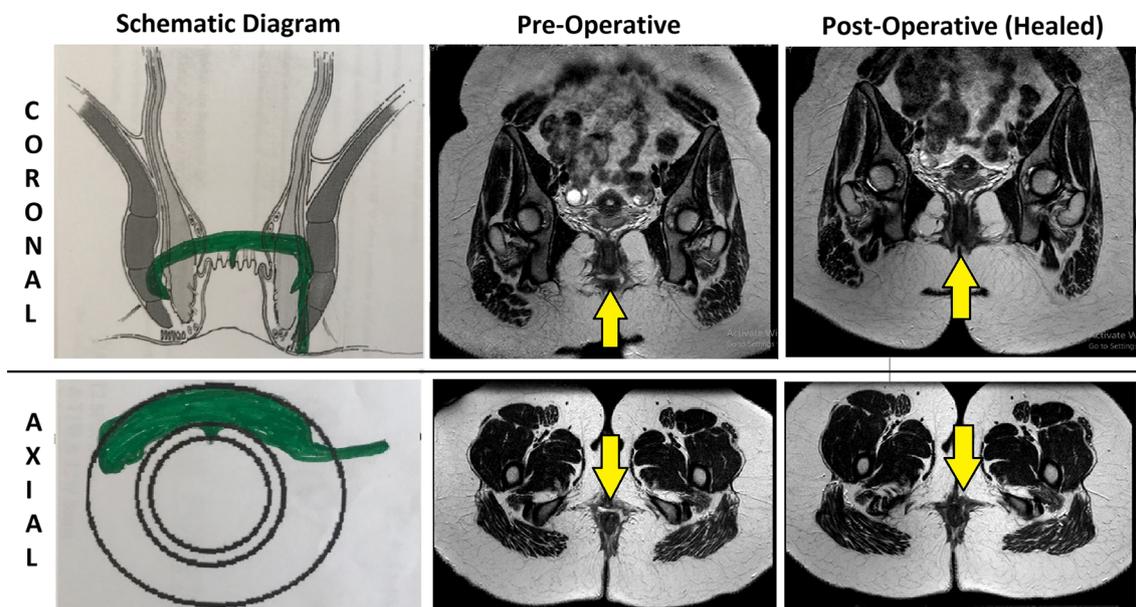
the prognosis of the disease [7, 10]. Moreover, Garg classification also guided regarding the management of the disease [7, 10]. Fistulotomy, the standard and the most

well-known fistula procedure, could be done safely in Garg grades I and II and should not be attempted at all in Garg grades III, IV and V as doing fistulotomy in these grades



**Fig. 3** Grade III (Garg) fistula—high transsphincteric with a single tract in a 58-year-old male patient. The tract was not reaching up to the skin and the patient presented with symptoms of pus discharge per anus. Left panels—schematic diagrams, middle panels—preoperative

MRI showing fistula tract (hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)

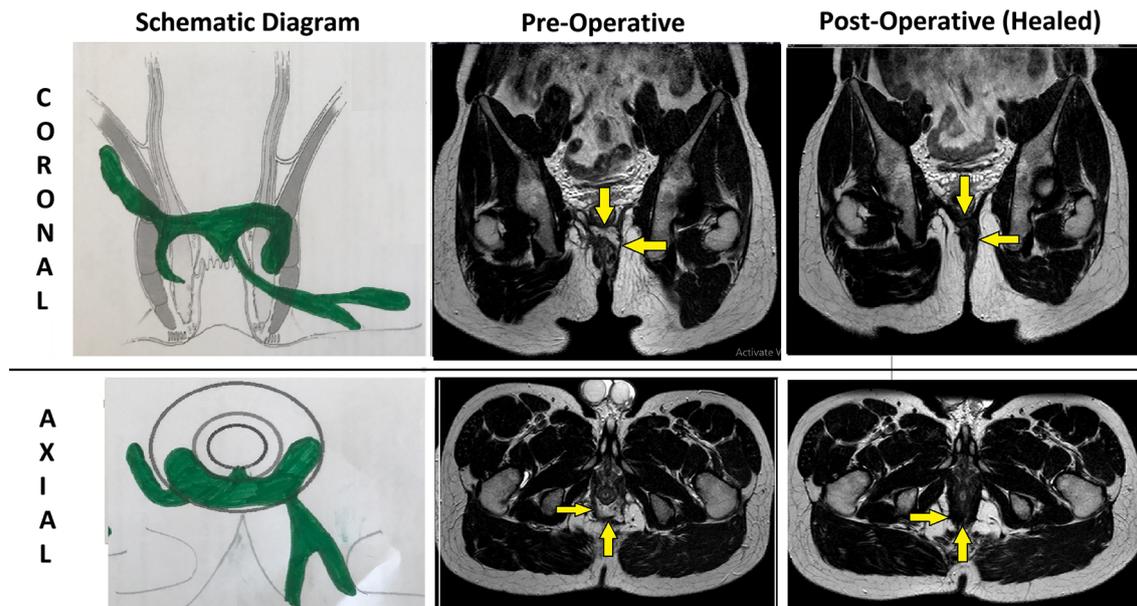


**Fig. 4** Grade III (Garg) fistula—anterior intersphincteric horseshoe fistula in a 32-year-old female patient. Left panels—schematic diagrams, middle panels—preoperative MRI showing fistula tract

(hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)

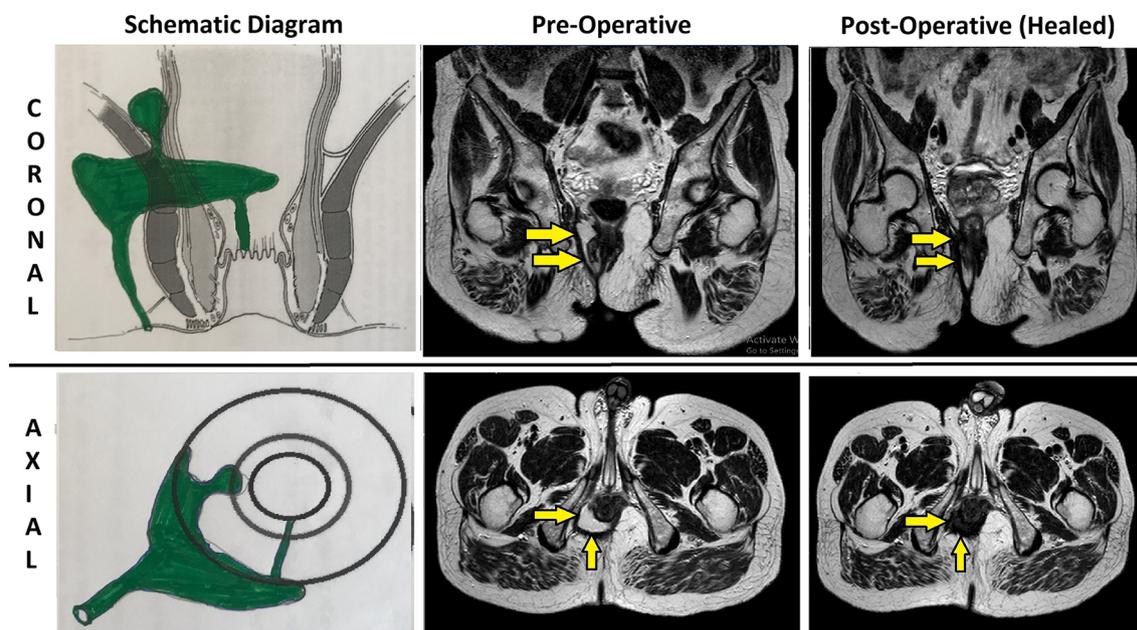
would entail a high risk of incontinence [5, 7, 10]. In this study, Garg grades I and II were categorized as simple fistulas and Garg grades III, IV and V were categorized as complex fistulas. Therefore, fistulotomy was done in grade I–II fistulas [5] and sphincter sparing procedure TROPIS (transanal laying open of intersphincteric tract) was done in

Garg grade III–V fistulas [4, 6]. In TROPIS procedure, the intersphincteric part of the fistula was laid open through the transanal route and was left open to drain well and subsequently heal with secondary intention. The tracts outside the external sphincter (in the ischioanal fossa) were thoroughly curetted. The principle behind this procedure



**Fig. 5** Grade IV (Garg) fistula—posterior intersphincteric horseshoe with high transsphincteric fistula in a 38-year-old male patient. Left panels—schematic diagrams, middle panels—preoperative MRI

showing fistula tract (hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)



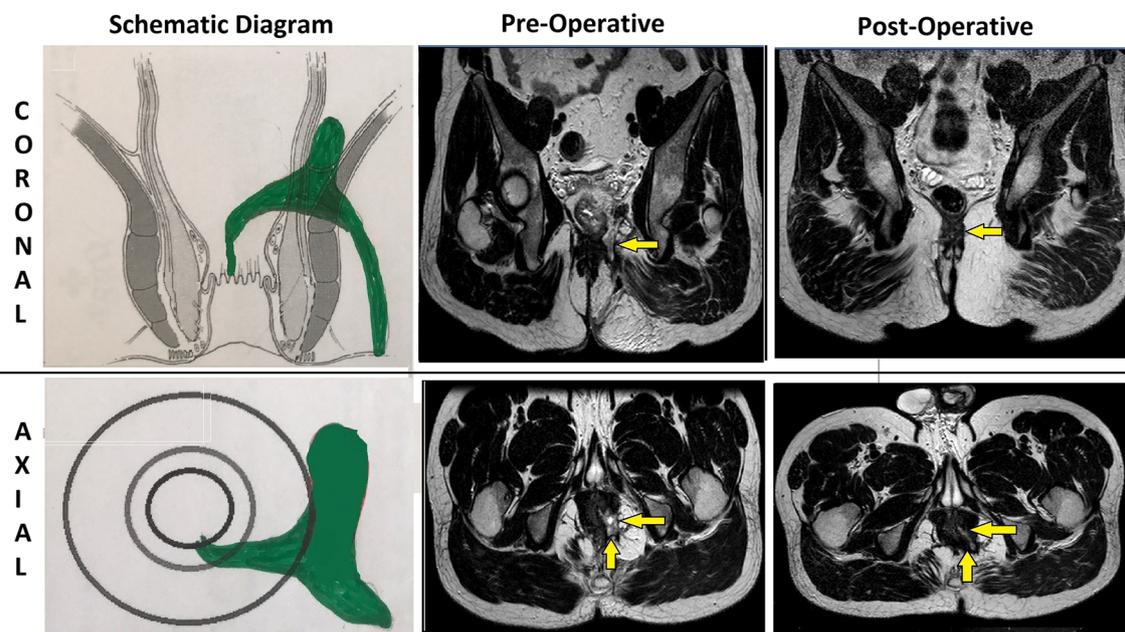
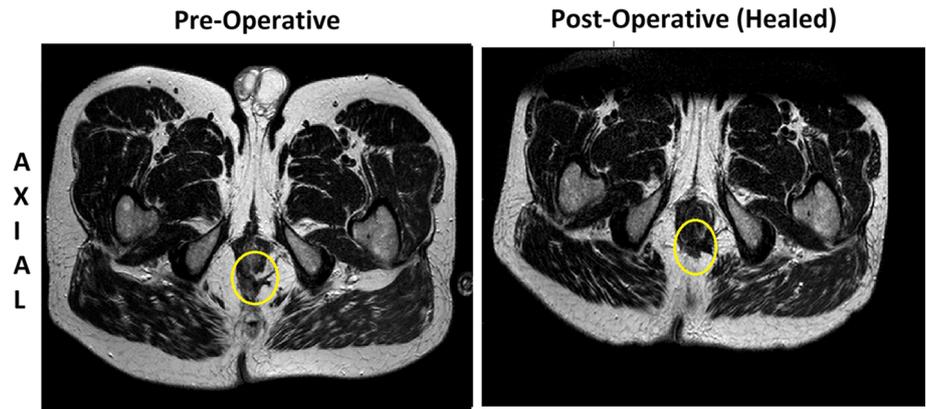
**Fig. 6** Grade V (Garg) fistula—high transsphincteric with a supralelevator extension at 9 o'clock position in a 52-year-old male patient. Left panels—schematic diagrams, middle panels—preoperative MRI

showing fistula tract (hyperintense on T2), right panels—postoperative follow-up MRI showing healed tracts (hypointense on T2)

was that intersphincteric tract was like an abscess (sepsis) in a closed space (intersphincteric space bound by two sphincters on both sides) [4, 11]. Therefore, proper deroofting of the abscess (into the rectal cavity through the

transanal route) was effective in healing these complex fistulas [6, 12].

**Fig. 7** Healed internal opening being seen in a posterior transsphincteric fistula in a 44-year-old male patient. Left panel—preoperative MRI showing a patent internal opening (small tract which pierced the internal sphincter and opened into the anorectum) (hyperintense on T2), right panel—postoperative follow-up MRI showing healed internal opening (hypointense on T2)



**Fig. 8** Grade V (Garg) fistula—high left transsphincteric with a supralelevator extension at 3 o’clock position in a 34-year-old male patient. Left panels—schematic diagrams, middle panels—preoperative MRI showing fistula tract (hyperintense on T2), right panels—

postoperative follow-up MRI showing residual non-healed tracts after 3 months (hyperintense on T2) even though clinically the fistula seemed to have healed well

**MRI imaging protocol**

The MRI scan examinations were performed on a 1.5 Tesla MR scanner (Achieva, Phillips Medical Systems, Best, Netherlands) using a phased-array four-channel sense body coil [1]. The long axis of the anal canal was identified by using a midline sagittal localizing sequence. Subsequent transfers and coronal short inversion recovery sequences were determined with respect to the anal canal axis. Additional coronal T-2 W and axial T-1 W scans with respect to anal canal axis were done in all the patients. Sagittal T-1-weighted images were used in approximately

10% of patient when a presacral extension was suspected from the transfer short inversion time recovery images. No endorectal/endoanal receiver coil or intravenous contrast material was used, and no three-dimensional reconstruction was done. Established criteria for MR diagnosis of fistula-in-ano were used. The radiologist noted her opinion of the internal opening, number of fistula tracts, associated features and the fistula classification. Most of the patients were operated within a week of their MRI scans. The median duration between the MRI scan and the operation was 1 day (interquartile range 6 days).

**Table 1** Fistula-in-ano classifications [7]

Classifications	Parks	St James University Hospital	Garg
Grade I	Intersphincteric	Intersphincteric single tract	Low linear intersphincteric Low linear transsphincteric (Fig. 1)
Grade II	Transsphincteric	Intersphincteric with abscess or secondary tract	Low complex intersphincteric or transsphincteric fistula with abscess, multiple, horseshoe tract (Fig. 2)
Grade III	Supralelevator	Transsphincteric single tract	High linear transsphincteric fistula (Fig. 3) Fistula with associated Crohn's disease, sphincter injury, postradiation exposure or anterior fistula in a female (Fig. 4)
Grade IV	Extrasphincteric	Transsphincteric with abscess or secondary tract	High transsphincteric fistula with either abscess, multiple or horseshoe tract (Fig. 5)
Grade V		Supralelevator translevator	High transsphincteric fistula with intersphincteric supralelevator extension (Figs. 6 and 7) Suprasphincteric fistula Extrasphincteric fistula

Low fistula: Less than 1/3 of external sphincter involvement, High fistulas: > 1/3 sphincter involvement

**Table 2** Comparison for patients in whom postoperative MRI done with the ones in whom postoperative MRI was not done

Garg classification grade	Total patients (n = 702)	Patients in which postoperative MRI done (n = 180)	Patients in which postoperative MRI not done (n = 522)	Postoperative MRI required
I	189	9	180	44/ 389
II	200	35	165	
III	52	16	36	136/ 313
IV	205	87	118	
V	56	33	23	

## Results

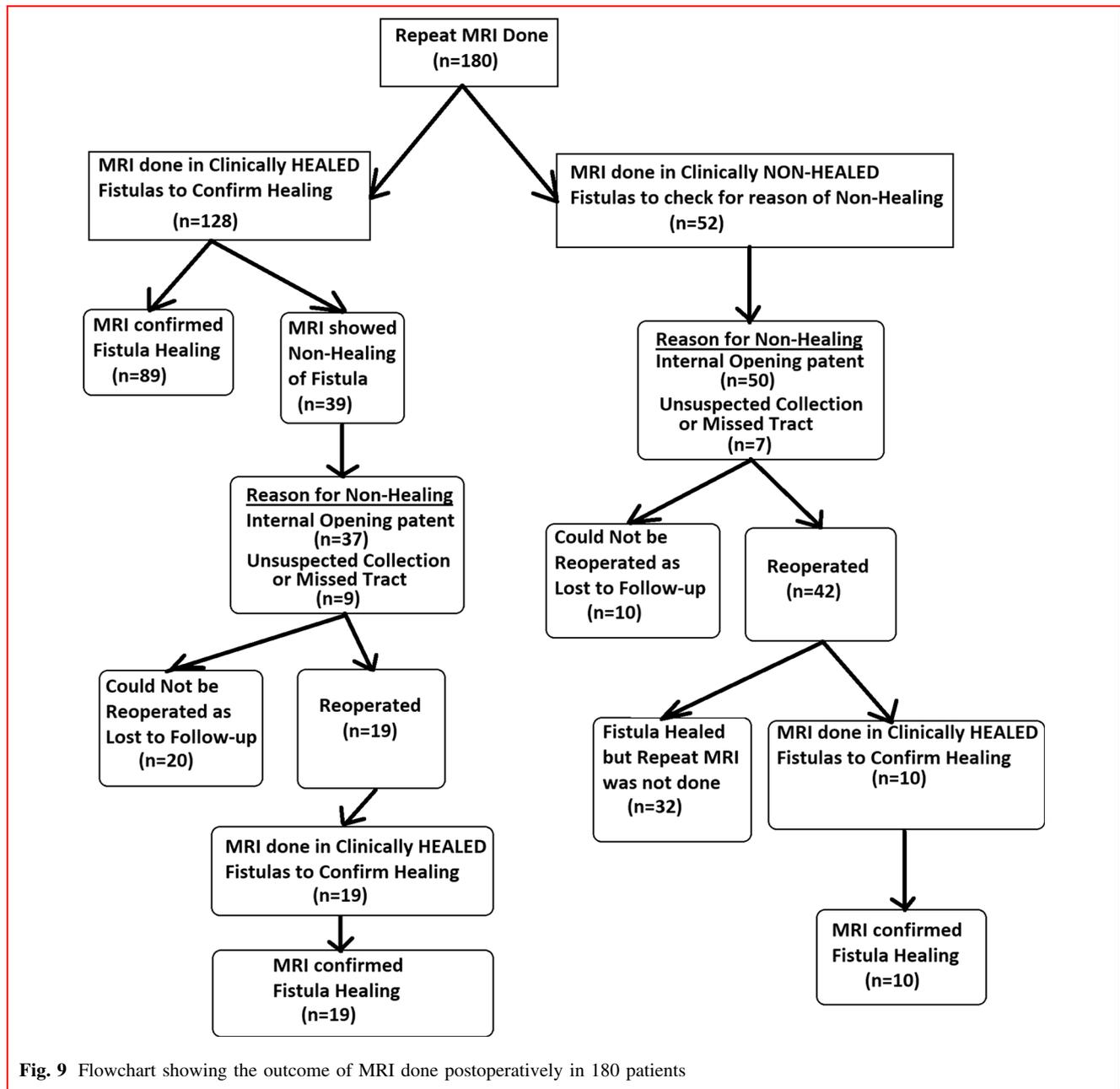
A total of 1323 MRI scans were done in 1003 patients suffering from fistula-in-ano between September 2012 and April 2018. Out of these, 702 patients underwent surgery for the fistula and 301 patients did not undergo surgery at our centre. In total, 1022 MRI were done in 702 operated patients—702 preoperative MRI in every patient and 320 postoperative MRI in 180/702 patients (Table 2). There

**Table 3** Fistula characteristics

Fistula parameter	Total patients (N = 702)
Recurrent	361 (51.4%)
Associated abscess	153 (21.8%)
Multiple tracts	388 (55.3%)
Horseshoe tract	146 (20.8%)
Supralelevator	76 (10.8%)

were 615 males and 87 females in the cohort. The mean age was  $38.9 \pm 10.2$  years, and there was a median follow-up of 29 months (2–67 months). There were 361 recurrent fistulas, 153 patients had associated abscess, 388 had multiple tracts, 146 had a horseshoe tract, and 76 patients had a supralelevator fistula (Table 3). There were no patients with Crohn's disease. As per Garg classification, there were 189 grade I, 200 grade II, 52 grade III, 205 grade IV and 56 grade V fistulas, and as per St James hospital university classification (SJUH), there were 151 grade I, 102 grade II, 88 grade III, 285 grade IV and 76 grade V fistulas. The requirement of postoperative MRI was significantly more in complex (Garg grades III–V) than simple fistulas (Garg grades I–II) [43.5% (136/313) patients of complex vs. 11.3% (44/389) patients of simple fistula required postoperative MRI,  $P < 0.0001$ , Fisher test- two tailed] (Table 2).

Postoperative MRI was done in 180 patients (Fig. 9). In 128/180 patients, MRI was done to confirm radiological healing in clinically healed fistulas. In 89/128 patients, MRI confirmed the healing. In 39/128 patients, MRI



demonstrated non-healed fistula. MRI showed patent internal opening in 37/39 and unsuspected pus collection/missed tract in 9/39 patients. Out of these 39 patients, 19 were reoperated, whereas 20 patients were lost to follow-up. MRI was done again after clinical healing in these 19 patients and it confirmed radiological healing in all of them (Fig. 9). In the remaining 52/180 patients, MRI was done in clinically non-healed fistulas to check for reasons of the non-healing. MRI showed patent internal opening in 50/52 and unsuspected pus collection/missed tract in 7/52 patients; 42/52 patients were reoperated and 10/52 were lost to follow-up. In 42 reoperated patients, after complete

healing clinically, 32 patients did not get repeat MRI, whereas 10 patients agreed for a repeat MRI. The latter confirmed radiological healing in all of them (Fig. 9).

#### Lessons learnt in interpreting postoperative MRI scans

MRI was quite accurate to assess the healing as well as the complications after anal fistula surgery. However, interpreting postoperative scans was quite challenging.

Granulation tissue (healing tissue) and inflammation in tissues (postsurgery) were difficult to differentiate from active fistula tract/pus as both looked hyperintense on T2 and STIR. Therefore, MRI done in immediate postoperative period (up to 8 weeks' postsurgery) required great care in interpretation and was easily misleading.

After complete healing, the tract and internal opening became hypointense on T2 and STIR.

The complete radiological healing usually took at least 10–12 weeks. So getting MRI scan for assessment of healing was best done after 12 weeks.

MRI was very accurate to identify and diagnose postoperative complications like abscess formation, non-healing fistulas or tracts which were missed intraoperatively/on preoperative scan. MRI detected such complications even in apparently clinically healed fistulas. By early intervention, it helped to prevent delayed recurrence, abscess formation and further spread of the infective process.

Closure/healing of the internal opening and healing of the intersphincteric tracts were assessed quite accurately by MRI, and they correlated quite well with the overall disease resolution.

## Discussion

The present study done in a large number of patients ( $n = 702$ ) provided valuable insight as how to interpret the postoperative MRI. It was not only the largest ever reported study of MRI done in anal fistulas but was also the first study in which postoperative MRI had been interpreted and compared to the preoperative MRI scans.

The interpretation of postoperative MRI required caution, care and constant correlation with the clinical condition. This was because on postoperative MRI scan, inflammatory changes due to the surgery and the healing granulation tissue looked similar to the active sepsis (infection) and the pus collection. Therefore, it was quite difficult to differentiate between the two opposite conditions for which the MRI was primarily being done—healing of the fistula on one side to the non-healing of fistula and postoperative complications on the opposite side. Due to this difficulty and lack of any data in the literature as how to interpret the postoperative MRI after fistula surgery, it took considerable time to learn as how to interpret the postoperative MRI scans. Due to the slow learning curve, the present study was not appropriate to analyse and calculate the sensitivity and the specificity of MRI in assessing fistula-in-ano in the postoperative period.

The difficulty in interpreting postoperative MRI was much more in the first eight weeks after surgery because

the postoperative inflammation was quite intense and predominated the radiological picture overshadowing other features. While planning the study, there was no short- or long-term schedule in the protocol according to which the postoperative MRI was to be done. MRI was done early (before 8 weeks) or late (after 8 weeks) depended on the clinical requirement. In the first 4–8 weeks after the operation, the main indication of getting MRI was to look out for any residual abscess or missed tract (missed intraoperatively or on the preoperative MRI scan). The signs of inflammation subsided radiologically only after 6–8 weeks and a fistula tract took at least 8–10 weeks or even longer for the complete healing on clinical examination. Therefore, the radiological assessment of fistula healing could be appropriately done at least after 10 weeks and preferably after 12 weeks as the complete resolution of the fistula disease on MRI was expected to lag the clinical resolution. Therefore, the later the MRI was done, the better was the assessment of the fistula healing.

In postoperative cases, MRI was quite accurate to assess the healing of the fistula tracts and to identify any residual/missed tract, especially the intersphincteric tracts, unsuspected collection and the healing/closure of the internal opening. Unidentified and improperly managed intersphincteric component of the fistula is one of the most common causes of fistula recurrence, especially in complex and supralelevator fistula-in-ano [4, 11, 13]. Therefore, accurate identification of the missed intersphincteric component of the fistula which was missed on the preoperative MRI helped to pick the cause of recurrence so that the corrective action could be taken expeditiously. The active infected intersphincteric tracts looked hyperintense on T2 and STIR images and became hypointense on complete healing.

Another significant advantage of the postoperative MRI was its ability to predict the healing/closure of internal opening. In 91/180 patients in whom postoperative MRI showed non-healing of fistula, MRI could highlight patent internal opening in 87 of them (Fig. 9). In MRI, the internal opening was identified by the small tract which pierced the internal sphincter and opened into the anorectum (Fig. 7). As is with other tracts, this small tract looked hyperintense on T2 and STIR images when the internal opening was patent. After complete healing of the internal opening, this small tract turned hypointense (on T2 and STIR) implying the closure of the internal opening (Fig. 7).

The importance of assessment of the internal (primary) opening closure cannot be overemphasized as the internal opening closure correlated quite well with the long-term fistula healing. Patent non-healed internal opening in an apparently clinically healed fistula would have a high risk

of a recurrence (Fig. 8). Similarly, improperly or missed out intersphincteric component could lead to a delayed recurrence which could happen even after few months or years. Before the advent of the sophisticated diagnostic modalities like MRI, it was not possible to assess the status of the internal opening and the intersphincteric component of the anal fistula in the postoperative period. Due to this, closure of the external opening and stoppage of pus discharge was taken as the sign of fistula closure (clinical healing). But now MRI could accurately depict the precise closure of the internal opening, healing of the intersphincteric component and resolution of all the external tracts in the postoperative period (radiological healing). The matching of both the clinical healing and the radiological healing went a long way in achieving a high long-term cure rate. This addressed one of the main issues associated with fistula-in-ano management which was uncertainty about the long-term cure rates.

In the present study, the method to assess MRI was quite rigorous having active participation of the radiologist and the operating surgeon. This was possible because the centre where the study was done was a dedicated fistula treatment centre. Such rigorous assessment may not be possible in all the hospitals. In most hospitals, reporting by radiologist coupled with basic understanding of the MRI by the operating surgeon should suffice. The detailed assessment involving discussion between the radiologist and the surgeon may be undertaken in only complex and recurrent fistula cases.

The latest advancements tried in MRI assessment of fistula-in-ano are the contrast-enhanced dynamic MRI [14] and the three-dimensional modelling [15]. The latter has been tried only in Crohn's fistulas and not in cryptoglandular fistulas. Both these advancements look promising and are likely to improve the understanding of the fistula-in-ano in the preoperative as well as the postoperative periods. However, neither of these recent advancements were used in the present study. This was a limitation of the study. The reason for this limitation was the lack of expertise and because the present study was initiated much before the advent of these advancements. Another limitation was lack of comparison with other useful diagnostic modalities like transrectal ultrasound.

To conclude, MRI was quite accurate to assess healing as well as complications after anal fistula surgery. Granulation tissue (healing tissue) and inflammation in tissues (postsurgery) were difficult to differentiate from active fistula tract/pus. Therefore, MRI done in immediate postoperative period (up to 8 weeks' postsurgery) required great care in interpretation and was easily misleading. The complete radiological healing usually took at least 10–12 weeks. So getting MRI scan for assessment of healing was best done after 12 weeks. MRI was very

accurate to identify and diagnose the postoperative complications like abscess formation, non-healing fistulas or missed tract (missed on preoperative scan/intraoperatively). MRI detected such complications even in apparently clinically healed tracts. MRI could accurately assess closure/healing of the internal opening and the intersphincteric tract and this correlated quite well with the long term fistula healing. However, further studies are needed to corroborate the findings of this study.

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**Author's contributions** Pankaj Garg contributed to concept, study design, acquisition of data, analysis of data, drafting, revising, final approval of the draft, submission of manuscript.

**Compliance with ethical standards**

**Conflict of interest** All authors have declared that they have no conflicts of interest.

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