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Comparative study of percutaneous (perianal) instillation of aqueous jelly & percutaneous (perianal) gadolinium instillation in MR fistulography with its surgical correlation

Dr. Satish D. Patil

Associate Professor, Department of Radiology, Shri B.M. Patil Medical College and Research center - BLDE University (DU), Vijayapur, Karnataka, India

Dr. Vishal Nimbale

Assistant Professor, Department of Radiology, Shri B.M. Patil Medical College and Research center - BLDE University (DU), Vijayapur, Karnataka India

*Corresponding author email: vishaldr78@gmail.com

Dr. Shivanand V. Patil

Professor, Department of Radiology, Shri B.M. Patil Medical College and Research center - BLDE University (DU), Vijayapur, Karnataka, India

Dr. Prakruti Patil

PG Student, Department of Radiology, Shri B.M. Patil Medical College and Research center - BLDE University (DU), Vijayapur, Karnataka, India

Abstract--Background: Perianal fistula is an abnormal tract connecting the anal canal and the perianal skin. Precise delineation of the tracts is necessary before surgery to know the anatomical details in order to prevent recurrences and incontinence. We studied the efficacy of percutaneous (perianal) instillation of aqueous jelly versus percutaneous (perianal) gadolinium instillation on magnetic resonance (MR) fistulography and compared to intra-operative findings. Materials and Methods: All patients with suspected peri-anal fistula showing external opening and active perianal discharge, who were sent for MR fistulography. MR fistulography with aqueous jelly instillation of perianal external opening was done on day 1, MR fistulogram with percutaneous (perianal) instillation of gadolinium contrast was performed next day which were correlated surgically. Results: A total of 30 patients underwent MR fistulogram with both modalities, of which, 28 of them underwent surgery. Out of the 28 patients with intra-operative primary tract, all 28 were identified to have the primary

tract. Secondary tract identification by aqueous jelly instillation showed sensitivity, specificity, PPV, NPV, and accuracy of 55.5%, 100%, 100%, 82.6%, and 85.7% respectively. Secondary tract identification by gadolinium instillation showed sensitivity, specificity, PPV, NPV, and accuracy of 77.7%, 100%, 100%, 90.4%, and 92.8% respectively. With respect to peri-anal abscess identification by both modalities, sensitivity, specificity, PPV, NPV, and accuracy of 71.4%, 100%, 100%, 91.3%, and 92.8% was obtained. Conclusion: Both the methods provide good delineation of the active primary fistulous tract. However, the visualization of secondary tracts was better with percutaneous gadolinium instillation.

Keywords--MR fistulography, aqueous jelly, gadolinium.

Introduction

Perianal fistula is an abnormal tract which connects the anal canal and the perianal skin. It is a commonly seen condition in surgical practice. It presents with discharge of pus from an external opening, itching, pain and perianal swelling. The main modality of treatment is surgery. [1] Improper excision can cause frequent recurrences and sphincter muscle damage during surgery which can lead to incontinence later. Hence a detailed and proper technique is required prior to surgery in improving the outcome.[2] In evaluating perianal fistula, MR Fistulography has become the method of choice since it displays the extensions of the disease and its characterization, targeting to completely eliminate all sources of infection and eventually reducing the recurrence rate. MR fistulography, IV Gadolinium MR fistulography, percutaneous instillation of aqueous jelly and percutaneous instillation of gadolinium are different methods of imaging for fistula in ano. [3]

Aqueous jelly is affordable and commonly available. Instillation into the external opening before imaging is an easy procedure and can be done regularly for better visualization. Being viscous in character, it provides persistent distension of the fistula. Aqueous jelly has a long T2 relaxation time, giving it an intrinsic contrast on T2 weighted imaging.[1] With percutaneous gadolinium instillation, the active fistulous tracts enhance well which helps in better delineation of the tract. [3] In this study, we conducted a comparative study of the accuracy of MR fistulography with percutaneous (perianal) instillation of aqueous jelly as well as percutaneous (perianal) instillation of gadolinium with surgical correlation of the intra-operative findings.

Materials and Methods

This was a prospective study which included all the patients with suspected perianal fistula showing external opening and active peri-anal discharge who underwent MR fistulography with both percutaneous (perianal) aqueous jelly instillation as well as percutaneous (perianal) gadolinium instillation with subsequent surgical correction during a 6 months period between August 2019 and February 2020. Patients who did not

undergo surgery or were unfit for surgery were excluded. Informed consent was taken prior to all three procedures.

Methods and procedure

On day 1, MR fistulography with aqueous jelly instillation of perianal external opening was done and on day 2, MR fistulogram with percutaneous (perianal) instillation of gadolinium contrast was performed. Hence, MR fistulography was performed twice i.e., once with aqueous jelly and once with gadolinium contrast.

Aqueous jelly MR fistulography

Patients were made to lie down in the prone position and external openings of the suspected peri-anal fistula were located. Under aseptic precautions, aqueous jelly was filled in a 10 ml syringe to which an infant feeding tube of 5 French size was attached. The external openings were gently cannulated. Around 5 ml of aqueous jelly was pushed into each external opening just before taking for MR. The injection was pushed until the jelly starts expelling out. Immediately following the instillation, MR fistulogram of the patients was done using a (GE Signa Explorer) 1.5 Tesla MRI scanner.

Percutaneous (perianal) Gadolinium MR fistulography

On the next day, percutaneous (perianal) instillation of contrast (a mixture of 1 ml of 0.01 mmol gadolinium with 20 ml saline) through the external opening was performed in the gantry with patient in prone position under aseptic precautions. Immediately following the instillation, MR fistulogram of the patients was done using a (GE Signa Explorer) 1.5 Tesla MRI scanner.

Imaging specifications

Imaging was done using T1WI, T2WI, inversion recovery (STIR), DWI and T1WI post contrast with fat suppression sequences in axial, coronal and rarely in sagittal planes. Slice thickness of 3 mm, F.O.V. of 25×25, and imaging matrix of 256×256 were taken.

Statistical methods

Sensitivity, specificity, Positive predictive value, Negative predictive value, and accuracy values of aqueous jelly MR fistulography and percutaneous (perianal) gadolinium contrast MR fistulography in relation to intraoperative findings for identification of peri-anal fistula tracts using 2-sided Mc Nemars test was used. To determine agreement between aqueous jelly MR fistulography and percutaneous gadolinium contrast MR fistulography with intra-operative findings, kappa statistics was applied. p value <0.05 was considered a statistically significant difference.

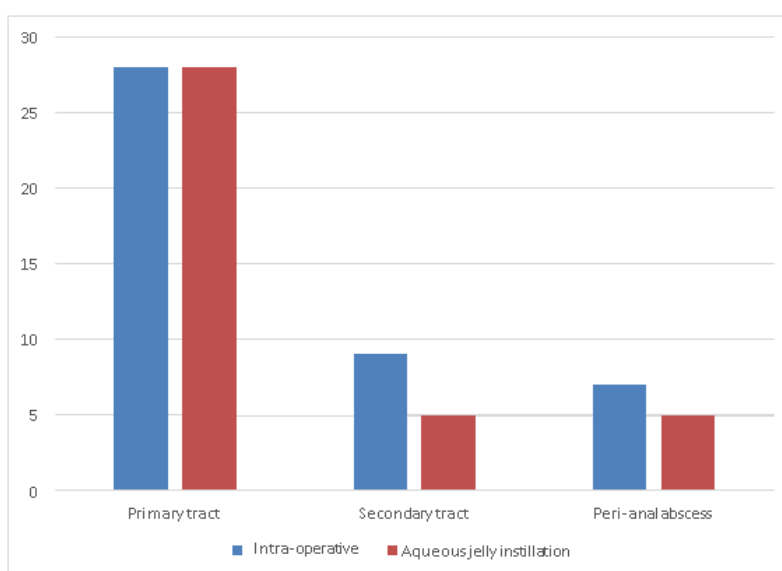
Results

A total of 30 patients underwent MR fistulogram with both contrast modalities, out of which, 28 of them underwent surgery and were included in the study. Out of these patients, 26 (92.9%) patients were male and 2 (7.1%) were females. The ages ranged from 15 to 61 years with a mean \pm standard deviation of 39.5 ± 10.9 years.

Surgical findings

Intra-operatively, 31 tracts were located in these 28 patients with 9 (32.1%) patients having multiple tracts. 20 (71.4%) patients had internal openings. 7 (25%) patients had a peri-anal abscesses

MR fistulography with aqueous jelly instillation

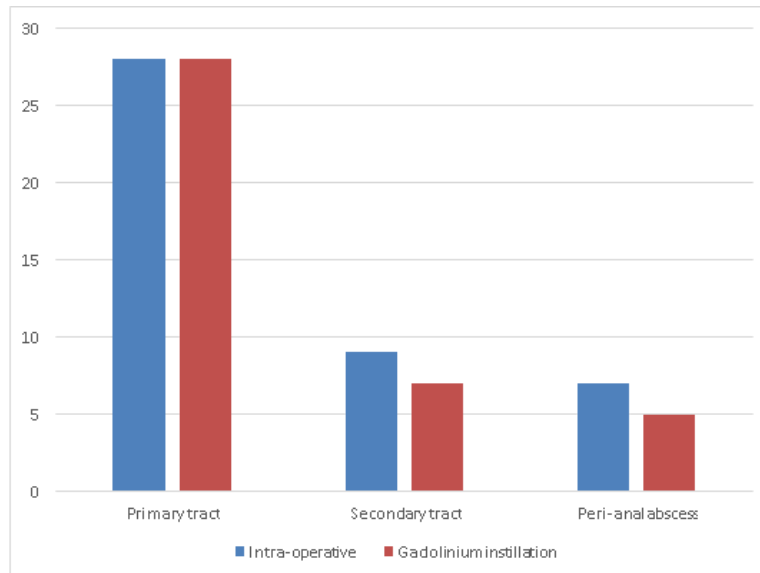


Graph 1. Comparison of MR fistulography with aqueous jelly instillation versus intraoperative findings

Out of the 28 patients, 20 (71.4%) had internal openings. 8 (28.6%) patients had only blind ending sinuses. Out of the 28 patients with intra-operative primary tract, all 28 were identified to have the primary tract with aqueous jelly instillation with a sensitivity, specificity, positive predictive values (PPV), negative predictive value (NPV), and accuracy of 100%, 100%, 100%, 100%, and 100% respectively [Graph 1]. With respect to secondary tract identification, out of the 9 patients with secondary tracts identified intra-operatively, MR fistulography with aqueous jelly instillation identified 5 (55.5%) patients. There was no statistically significant difference ($p=0.1336$) with a sensitivity, specificity, PPV, NPV, and accuracy of 55.5%, 100%, 100%, 82.6%, and 85.7% respectively when intra-operative findings were considered a gold standard [Graph 1]. With respect to peri-anal abscess identification, out of the 7 patients with perianal abscesses identified intra-operatively, MR fistulography with aqueous jelly instillation

identified 5 (71.4%) patients. There was no statistically significant difference ($p=0.4795$) with a sensitivity, specificity, PPV, NPV, and accuracy of 71.4%, 100%, 100%, 91.3%, and 92.8% respectively when intra-operative findings were considered a gold standard [Graph 1].

MR fistulography with percutaneous (perianal) gadolinium instillation



Graph 2. Comparison of MR fistulography with percutaneous gadolinium instillation versus intra-operative findings

Out of the 28 patients, 21 (70%) had internal openings. 7 (30%) patients had only blind ending sinuses. Out of the 28 patients with intra-operative primary tract, all 28 were identified to have the primary tract with percutaneous gadolinium instillation with a sensitivity, specificity, PPV, NPV, and accuracy of 100%, 100%, 100%, 100%, and 100% respectively [Graph 2]. With respect to secondary tract identification, out of the 9 patients with secondary tracts identified intra-operatively, MR fistulography with percutaneous gadolinium instillation identified 7 (77.7%) patients. There was no statistically significant difference ($p=0.4795$) with a sensitivity, specificity, PPV, NPV, and accuracy of 77.7%, 100%, 100%, 90.4%, and 92.8% respectively when intra-operative findings were considered a gold standard [Graph 2]. With respect to peri-anal abscess identification, out of the 7 patients with perianal abscesses identified intra-operatively, MR fistulography with percutaneous (perianal) gadolinium instillation identified 5 (71.4%) patients. There was no statistically significant difference ($p=0.4795$) with a sensitivity, specificity, PPV, NPV, and accuracy of 71.4%, 100%, 100%, 91.3%, and 92.8% respectively when intra-operative findings were considered a gold standard [Graph 2].

Discussion

Perianal fistula is commonly encountered and may become chronic and recurrent. It can also present with various complications such as secondary tracks and

abscesses. The lack of proper evaluation of these complications can result in residual and recurrent disease. Hence, a complete pre-operative evaluation of perianal fistulas is needed. Also, to prevent intraoperative injury to the external sphincter and resultant fecal incontinence, it is necessary to establish the relationship of the sphincter with the fistulous tracks. MR can satisfy all these needs of the surgeons and helps in planning of the surgery. MR can provide fine anatomic details of the fistula with pre-operative identification of the secondary tracks and abscesses (Figure 1, 2), resulting in a better surgical outcome. [2]

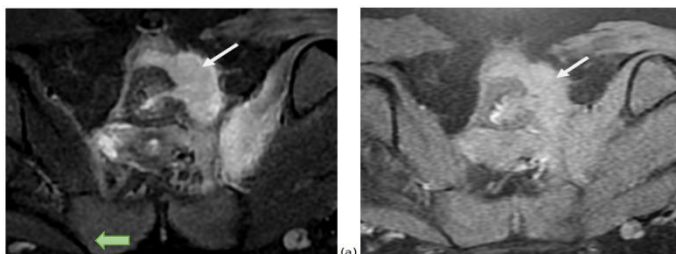


Figure 1. Axial T2 fat suppressed (a) image showing trans-sphincteric fistula (short arrow) opening at 9 o clock position with abscess formation (long arrow), T1 fat suppressed sequences (b) showing same findings

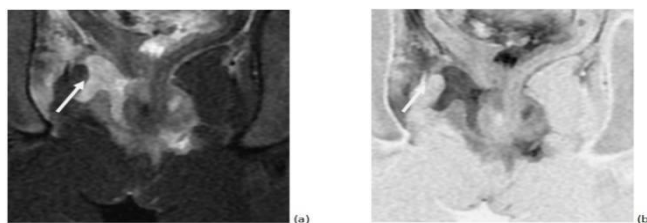


Figure 2. Coronal T2 fat suppressed sequence (a) showing bilateral trans-sphincteric fistula with right ischiorectal abscess (arrow) and inverse image (b) of the same which is able to delineate the fistula and abscess better

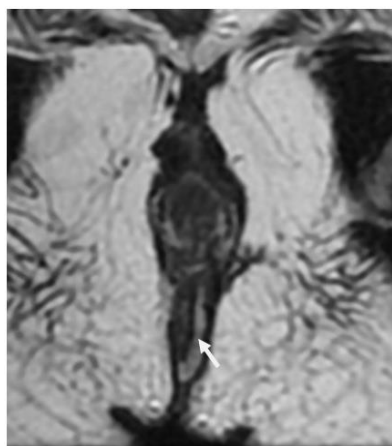


Figure 3. Coronal T2 weighted fat suppressed sequence showing simple intersphincteric fistula (arrow) with internal opening at 6 o' clock position

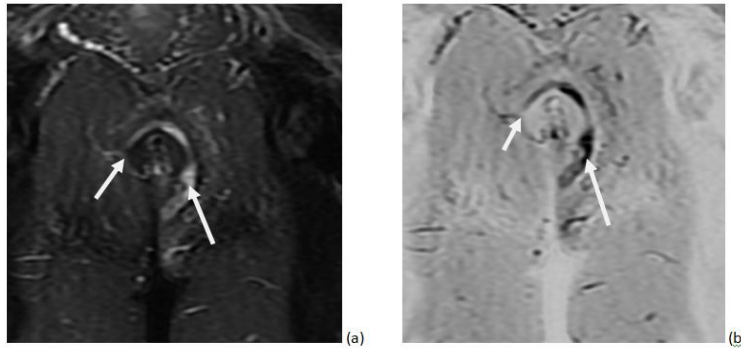


Figure 4. Coronal T2 STIR (a) and inverse image (b) showing horseshoe intersphincteric fistulas (arrows) with percutaneous aqueous jelly instillation which can be clearly seen showing increased signal intensity

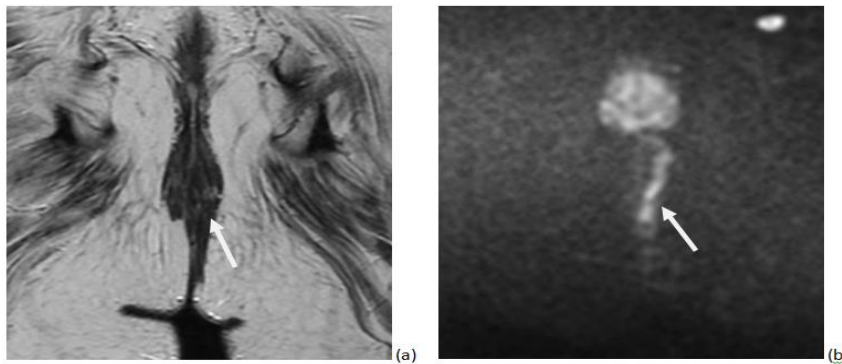


Figure 5. Coronal T2 fat suppressed (a) and DWI (b) showing intersphincteric fistulous tract (arrow) which shows diffusion restriction which supplements the T2 weighted image in diagnosing

Un-enhanced T1W images yield good anatomic details. However, tracks and infective collections such as abscesses show low to intermediate signal intensity and hence becomes difficult to delineate from the normal musculature. On T2W images (Figure 3) and STIR images (Figure 4), the pathologic processes may be better visualized as they show high signal intensity as shown in the images. ^[4] Diffusion-weighted imaging can be used for the assessment of fistula as well. Inflamed tissues show high signal intensity in DWI (Figure 5). Therefore, it may be used to supplement T2 W sequences for localizing fistulous tracts. ^[5] A study conducted by Hori et al. showed excellent diagnostic accuracy, sensitivity, specificity, and predictive values of T2W images with DWI, providing improved efficacy in diagnosing fistulous tracts. ^[6] Yildirim et al. Reported that contrast-enhanced T1 weighted imaging may help to delineate the primary tract, ramifications, and internal openings precisely with enhancement of the smaller tracts. ^[7]

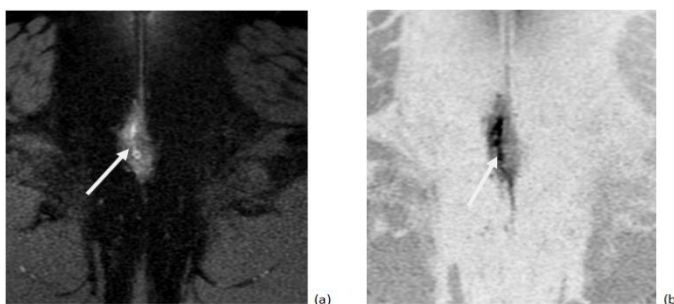


Figure 6. Axial T1 fat suppressed image with percutaneous (perianal) gadolinium instillation (a) showing simple linear intersphincteric fistula (arrow) which is hyperintense with adjacent inflammatory changes and inverse image (b) of the same

MR without intravenous gadolinium has been thought to have disadvantages in delineating the smaller tracts and chronic tracts on T2 WI, since they are not usually hyperintense. Contrast enhanced FS T1 imaging sequence can better identify the primary fistulous tract, internal openings, lateral ramifications, as well as improves visualization of the smaller tracts.^[1] Gadolinium shortens the T1 time and hence makes the walls of the fistulae more evident (Figure 6). With gadolinium, the chronic tracts & scar tissue may not show any enhancement.

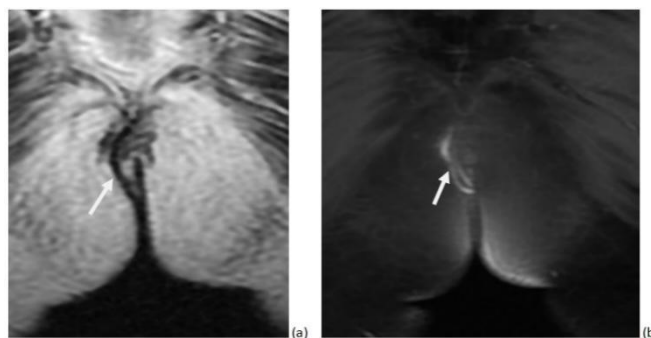


Figure 7. Coronal T2 fat suppressed and Axial T1 fat suppressed image with percutaneous gadolinium instillation showing simple trans-sphincteric perianal fistula (arrow)

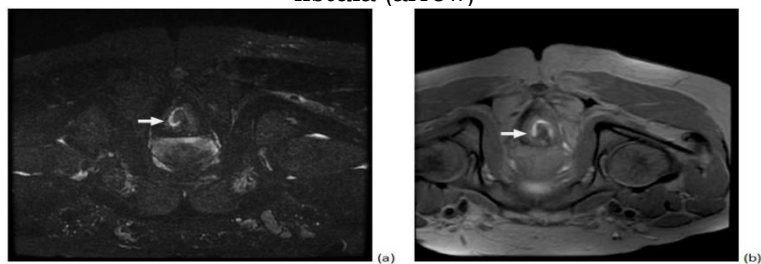


Figure 8. Axial T2 fat suppressed image with percutaneous aqueous jelly instillation (a) showing intersphincteric fistula (arrow) and Coronal T1 fat suppressed image with percutaneous gadolinium instillation (b) showing the intersphincteric fistula

Major disadvantages of intravenous gadolinium include the non-distension of the tracts thus making it less valuable in identifying narrow tracts. However, with the invasive nature of intravenous contrast administration as well as risks associated with intravenous gadolinium administration, other modalities of contrast administration are being increasingly studied. Waniczek et al. assessed the advantage of percutaneous instillation of gadolinium (Figure 7) and normal saline into the fistulous tract to distend it for better visualization of the primary fistulous tract and found that it had good correlation with intra-operative findings. [8] Another technique which can be used as an alternative to intravenous contrast administration includes the use of aqueous jelly. Aqueous jelly is affordable and viscous in character hence, provides persistent distension of the fistula. Aqueous jelly has a long T2 relaxation time; giving it an intrinsic contrast (Figure 8) on T2 weighted imaging. [1] Since, it is an easy procedure; it can be done on a regular basis for better outcome.

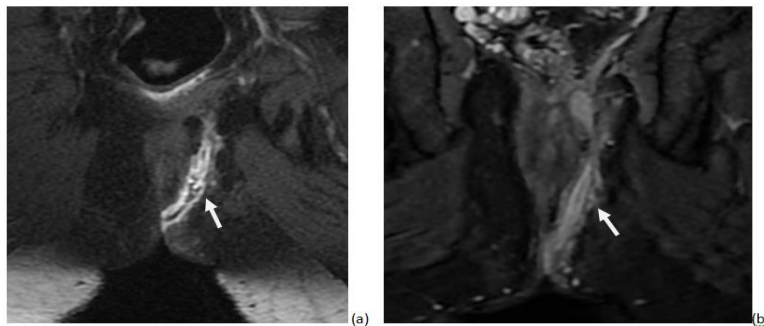


Figure 9. Coronal T1 fat suppressed image with percutaneous gadolinium instillation (a) showing intersphincteric fistula (arrow) which is hyper intense and can be delineated better than Coronal T1 fat suppressed image with percutaneous aqueous jelly instillation (b)

Our study demonstrated similar findings with both the methods of contrast administration that were studied with the percutaneous instillation of gadolinium (Figure 9) showing marginally better results with the identification of secondary tracts. Both aqueous jelly as well as percutaneous gadolinium instilled MR fistulography showed results on par with intraoperative findings in identifying the primary fistula tract. Our study also demonstrated an excellent and accurate agreement between the surgical findings and both modalities of MR fistulographies in identification of all the studied parameters, i.e., primary tract, secondary tract, and peri-anal abscesses.

Therefore, the advantages of percutaneous (perianal) gadolinium instillation are that it appears very bright and helps in easy identification of the tract. Also, the secondary tracts are better delineated. The advantages of aqueous jelly are that, it is cost-effective method and easily available. Also, there are no contrast related complications. Disadvantages of percutaneous (perianal) gadolinium instillation are that it is expensive; hence not affordable to everybody. Disadvantages of aqueous jelly are that the brightness of the tract is less compared to gadolinium and also secondary tracts are less visualized as compared to gadolinium.

The treatment options for peri-anal fistulas include surgical procedures such as fistulotomy, fistulotomy with marsupialization, fistulectomy, seton placement, closure of internal opening using advancement flap repair. [9,10] Treatment is not needed in asymptomatic individuals (i.e. without purulent discharge). The simple & low-lying fistula is treated only with an incision wherein the healing takes about 6 months. [11] Our study did have its limitations. First, it was a single center study and the results cannot be generalized. Second, there may be reporter bias in the reporting of the MR fistulography with an element of subjectivity based on the reporting radiologist. Third, the sample size was relatively low and a higher sample size could have added strength to the study. Finally, the history of previous surgical interventions in the studied patients was not collected and hence this could have influenced the imaging findings by virtue of altered anatomical structure.

Conclusion

Both the methods of contrast instillation in MR fistulography provided excellent delineation of the active primary fistulous tracts and good agreement with intra-operative findings in perianal abscesses. However, in the visualization of secondary tracts, percutaneous gadolinium instillation was found to be superior to aqueous jelly instillation when compared to intra-operative findings. Further larger studies may be indicated to validate our findings and add strength to the use of these contrast modalities in MR fistulography prior to surgical intervention.

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