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Role of Magnetic Resonance Imaging in the Preoperative Evaluation of Perianal Fistulas

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ABSTRACT:

Perianal fistula is an abnormal communication between the epithelial surface of the anal canal and skin as a hollow fistulous tract which is lined by granulation tissue. Fistula-in-ano has a tendency to chronicity and very much affect quality of life of an individual. Imaging of perianal fistulas is an important part of management as magnetic resonance imaging provides accurate information on the anatomy of the anal canal, the anal sphincter complex and relationship of the fistula to the structures of pelvic floor. Magnetic Resonance Imaging can accurately demonstrate inflammatory changes, secondary tracts, ramifications and abscesses which can be missed on conventional fistulography. MRI has been considered the gold standard technique for perianal fistula assessment because it provides the clinician with an accurate roadmap to select the best surgical approach. The aim of the article is to review the role of magnetic resonance imaging in preoperative assessment of perianal fistula, tracing its relationship, diagnosis and classification of perianal fistulae.

Keywords: perianal, fistula, fistula-in-ano, MRI, abscess

1. Introduction and Background:

Perianal fistula is a hollow tract or cavity lined by granulation tissue that connects anal canal or rectum to the skin around anus [1]. The opening in anal canal is called internal opening whereas perianal opening is called external opening. There can be single or multiple secondary openings extending from same primary opening in anal canal. The incidence rate ranges from 2 to 3 per 10,000 population with fistula-in-ano showing higher male predilection [2,3]. Many anal fistulas are due to the result of obstruction and infection of anal glands that open into the anal crypts at the dentate line with secondary abscess formation and external rupture through one of routes known as the cryptoglandular hypothesis [3-5]. The major problem associated with fistula in ano include discomfort resulting from continuous perianal discharge and local pain due to inflammation leading to hygienic problems and this may cause serious complications such as septicaemia [6]. It is important to properly assess these fistula-in-ano because surgical intervention must be aimed at not only eradication of fistulous tract by eradication of source of infection but also maintenance of continence which depends on maintenance of anal-sphincter complex [7]. Thus, pre-operative assessment of fistula-in-ano is one of the crucial components in management. Fistula-in-ano is a tedious problem because of high rate of recurrence and severe complications postoperatively with a history of previous any intervention for a fistula.

2. Materials and Methods:

The prospective observational study which included patients with fistula-in-ano were included on the basis of inclusion and exclusion criteria. The study was conducted in the time period from August 2022 to August 2023 in the department of Radiology of Meenakshi Medical College Hospital and Research Institute, Kanchipuram. The patients underwent MRI examinations on Siemens 1.5 Tesla system.

Relevant anatomy:

Anal canal: It is a tube-like structure that extends from the anus to the rectal ampulla surrounded by the internal and external sphincters which are muscular layers. It is 3–5 cm in length and are shorter in female than in male.

Somatic skin should theoretically reach the anal margin but in fact it reaches upto a point approximately halfway along the anal canal. The proximal half of the anal canal is characterized by longitudinal mucosal folds known as the anal columns of Morgagni. The distal part of each column is connected to its surroundings by small folds known as the anal valves which form pockets called the crypts of Morgagni. Dentate or pectinate line is the most distal potion of anal transition zone which is roughly 2-2.5 cm proximal to the anal verge. Squamous epithelium becomes transitional to columnar epithelium through a transition zone at the dentate line [8]. (Figure:1 and 2)

Figure 1: Diagrammatic representation demonstrating normal perianal anatomy in axial plane at the level of ischiorectal fossae.

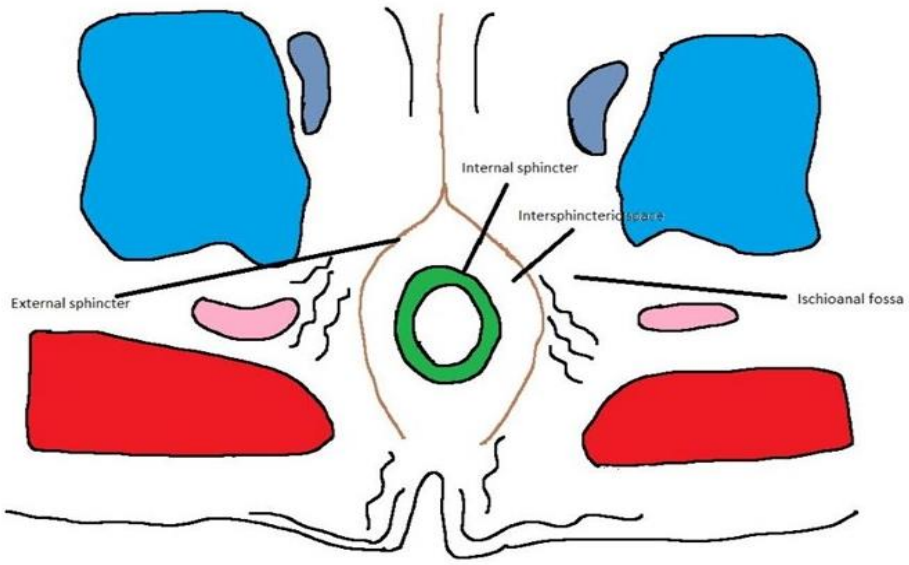
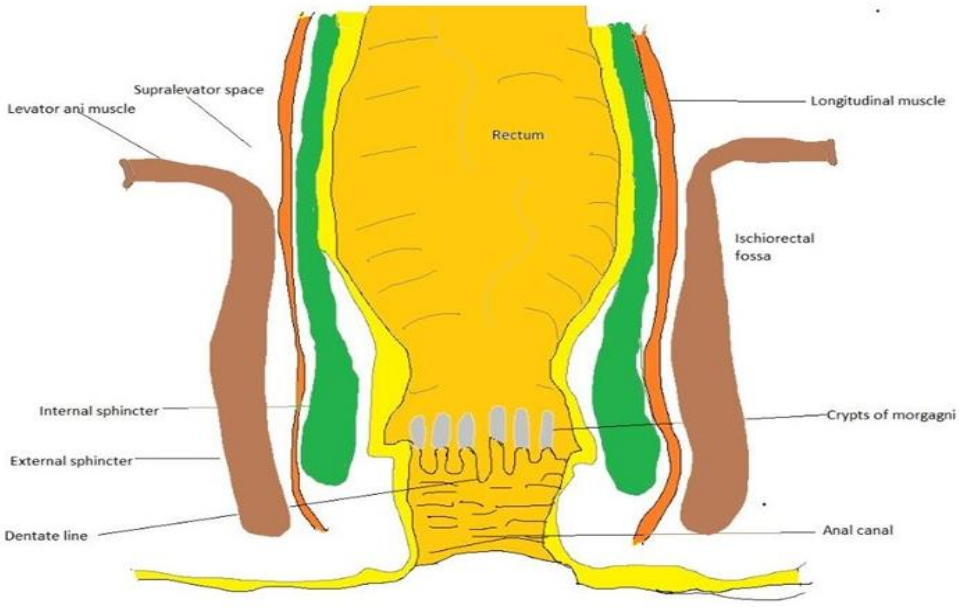


Figure 2: Diagrammatic representation demonstrating normal perianal anatomy in coronal plane at the level of ischiorectal fossae.



Internal sphincter: It is composed of smooth muscle which are continuous with the circular smooth muscle of the rectum [9]. This sphincter contracts involuntarily and contributes 80 % of the resting anal tone [10].

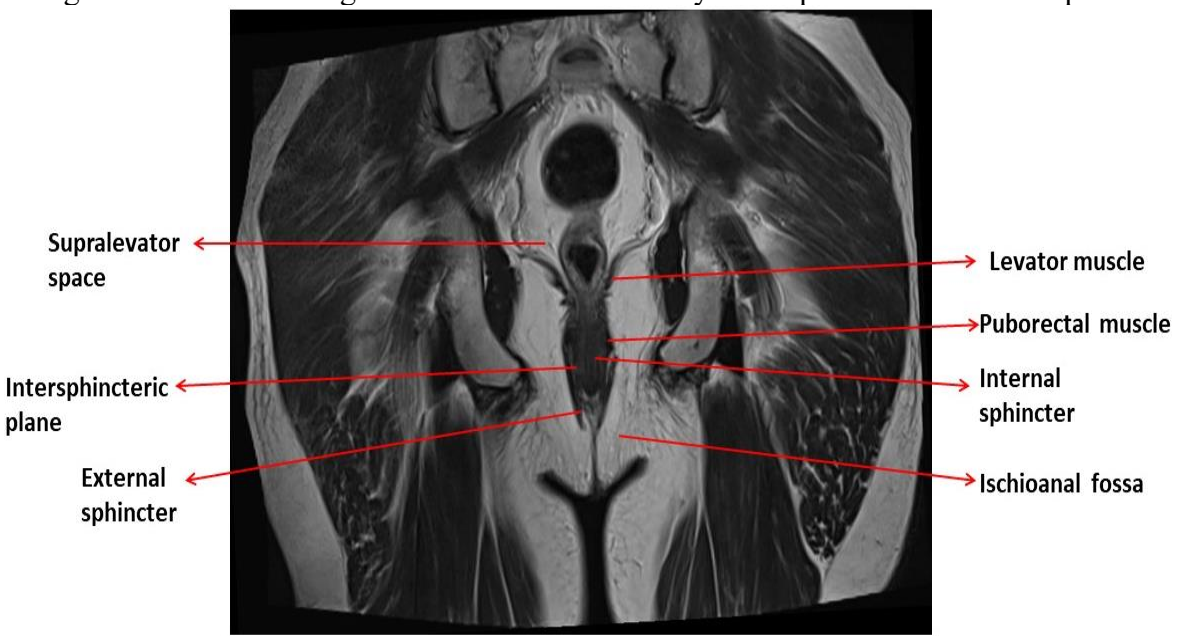
External sphincter: It is composed of striated muscle which is posteriorly attached to the anococcygeal ligament and anteriorly attached to the perineal body and urogenital diaphragm. It merges proximally with the puborectalis muscle which then merges with levator plate [11]. This sphincter contracts voluntarily and contributes 20 % of the resting anal tone and prevent

excretion [10]. The puborectalis muscle is the distal most part of the levator ani muscles which separates the perineum from pelvic cavity.

The internal sphincter can be divided with no such loss of continence but cutting up of the external sphincter can lead to fecal incontinence. These sphincters are separated by intersphincteric space which contains connective tissue, adipose tissue and muscle. This space leads to formation of a plane of lower resistance in which pus and fistula can spread [12]. (Figure: 3 and 4)

Figure 3: T2W MR image show the normal male anatomy of the perineum at the level of the mid anal canal in the axial plane.

Figure 4: T2W MR image show the normal anatomy of the perineum in coronal plane.



The anal glands were first described by Chiari [13] in 1878, are seven to 10 branched glandular structures which is lined by stratified columnar epithelium. The glands are distributed around the anal canal with ducts opening into the crypts of Morgagni which are located above the anal valves at the level of the dentate line. These glands are subepithelial but some branches may pass through the internal sphincter to end in the areolar tissue of the intersphincteric space [13]. Anal gland branches might extend over an area of approximately 1 cm^2 but as a rule there is no extension out into the external sphincter. Anal glands provide a channel facilitating the spread of infection from the anal lumen deep into the sphincter muscles, from where it may spread secondarily in any direction [8,14].

Etiology and Pathology:

Hazard variables for perianal fistulas are caused by few incendiary conditions involving pelvic disease, tuberculosis, Crohn infection [15], diverticulitis, pelvic harm, trauma amid childbirth and radiation treatment. Most acknowledged hypothesis about the cause of perianal fistula is the cryptoglandular theory [12], where intersphincteric gland infection represents the first event which leads to formation of an intersphincteric fistula track or abscess if the draining channel is obstructed. Persistent disease within the intersphincteric plane at the essential location leads to formation of a long-standing releasing fistula or abscess. If an abscess develops in a superficial gland, it is most likely to discharge into the anal canal. If the abscess is located deep to the internal sphincter, the sphincter can act as an obstruction. In such situations, rupture of the abscess results in pus formation traveling along the intersphincteric space and an intersphincteric fistula will form when it comes outside to the external surface of the skin [12]. Contamination may pass through both layers of the external sphincter shaping a transsphincteric fistula and enter the ischiorectal fossa causing irritation and abscesses [8]. The cryptoglandular speculation cannot clarify formation of fistulas in inflammatory processes such as Crohn infection and diverticulitis, which result in development of extrasphincteric fistulas, with a coordinate communication between the rectum and perineum or other visceral structures such as vagina, with no inclusion of the anal canal.

Role of MRI Technique:

Magnetic resonance imaging (MRI) is a technique that uses a magnetic field and radiofrequency pulse waves to image body organs, muscles, bones and blood vessels.

MRI protocol and sequence for perianal fistulas:

Axial T1W, Axial and coronal T2W TSE, Axial and coronal T2W FS or STIR, Axial and coronal T1W FS with intravenous gadolinium contrast.

Merits of MRI:

1. No radiation introduction.
2. High degree soft-tissue contrast resolution.
3. Provide all the necessary details.
4. Can be used for both functional and anatomical assessment at once.
5. Way better understanding compliance in comparison to routine fistulography and endoanal ultrasound.

Demerits of MRI:

1. Time consuming.
2. Costly.
3. Lesser accessibility.
4. Claustrophobia among patients.

The Anal Clock:

Within the lithotomy position, the left lateral aspect of the anal canal at 3 o'clock and the right lateral aspect at 9 o'clock, the anterior perineum is located at 12 o'clock and the natal cleft is at 6 o'clock [3]. It compares precisely with the view of the anal canal on axial magnetic resonance images obtained with the patient in the supine position. (Figure: 5 and 6)

Figure 5: Diagrammatic representation demonstrating anal clock in axial plane.

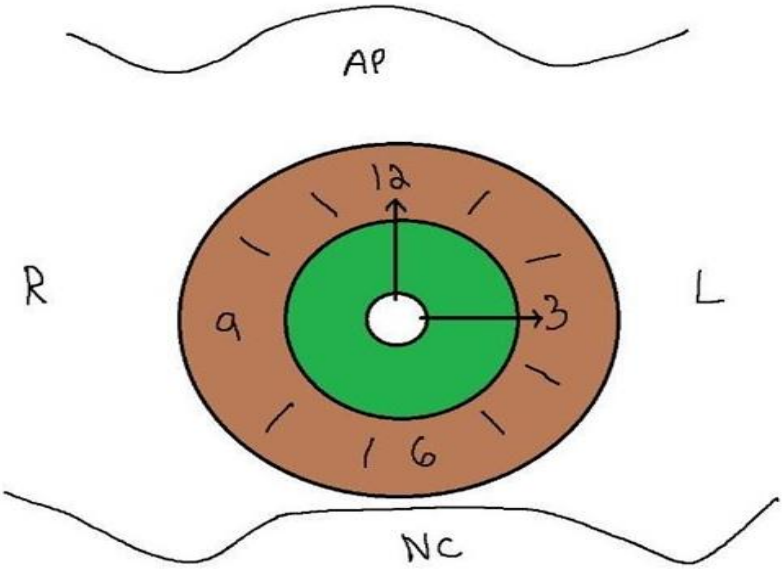
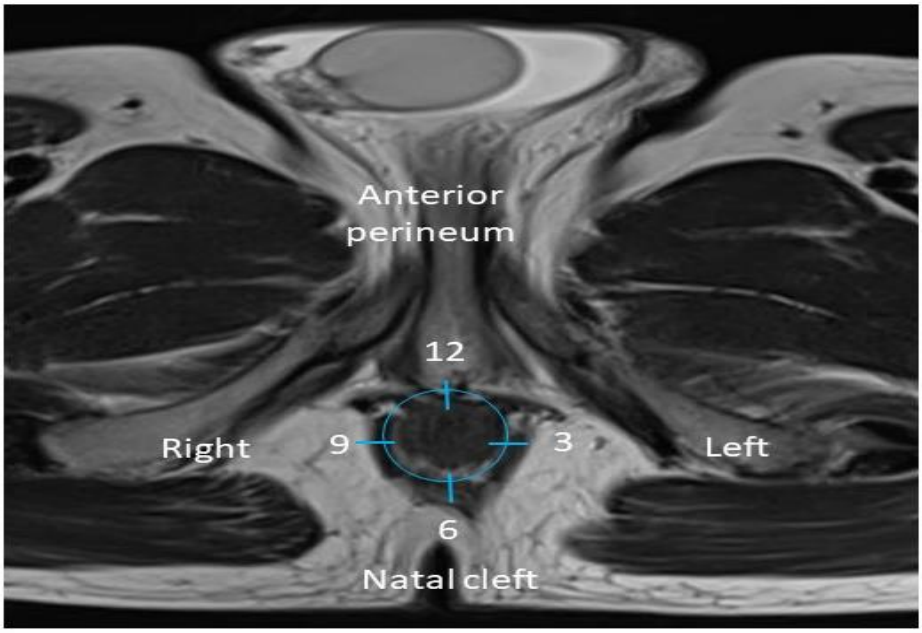


Figure 6: Axial T2W MR image of the male perineum shows the anal clock diagram which is used to locate anal fistulas with respect to the anal canal.



Classification of Perianal Fistulas:

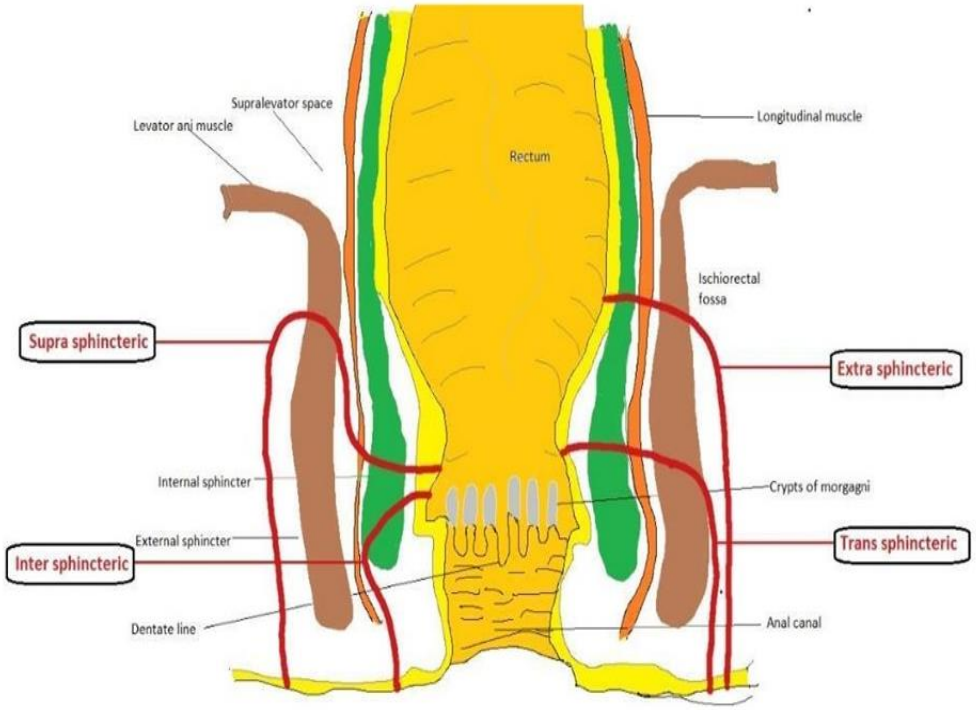
Fistulas are classified according to the course taken by the primary track from the anal canal to the skin. Perianal fistulas should be classified on the basis of relationship between the primary track and the anal sphincter muscles since the treatment involves separating and preserving the

structures necessary to maintain rectal continence. The two fundamental classification frameworks which are mainly used for perianal fistulas are the Parks classification on the basis of surgical classification [16] and the St James's University Hospital classification on the basis of radiological classification [3].

Parks Classification:

It portrays the tracts in coronal plane and also details its association with the internal and external sphincters. The external sphincter is the cornerstone in the Parks classification. Fistulas are classified into four types: Intersphincteric, Transsphincteric, Suprasphincteric and Extrasphincteric. (Figure: 7)

Figure 7: Diagrammatic representation demonstrating types of perianal fistulas as described in the Parks classification.



Intersphincteric fistulas: Most common. The track ramifies only within the intersphincteric space and does not navigate the external sphincter, which forms an obstruction to the spread of infection. The tract runs between the internal and external sphincters and may reach the perianal skin through or medial to the subcutaneous external sphincter.

Transsphincteric fistulas: The tract amplifies from the intersphincteric space through the external sphincter into the ischiorectal fossa.

Suprasphincteric fistulas: The tract passes upward into the intersphincteric space and amplifies over the puborectalis muscle and at that point comes down through the levator plate to the ischiorectal fossa and finally to the skin.

Extrasphincteric fistulas: The tract passes from the perineal skin then to ischioanal fossa and then through levator muscles and finally into the rectum. This fistula totally lies exterior the external sphincter. In this manner, no disease is found within the intersphincteric space and the anal canal is not included.

St James's University Hospital Classification:

It is the magnetic resonance imaging-based classification that relates Parks surgical classification to the anatomic MRI findings in the coronal and axial planes. The main part of

radiologists is to be descriptive and accurate in interpreting and formulating reports as detailed report will be accommodating in further administrative management about medical or surgical treatment. This classification not only deals with the primary fistulous track but moreover also with secondary extensions and abscesses in assessment and grading of fistulas. This classification grades fistulas into five types:

Grade 1: Simple straight intersphincteric fistula. (Figure: 8 and 9)

Figure 8: Grade 1: Axial STIR image shows simple linear intersphincteric fistula (arrow).

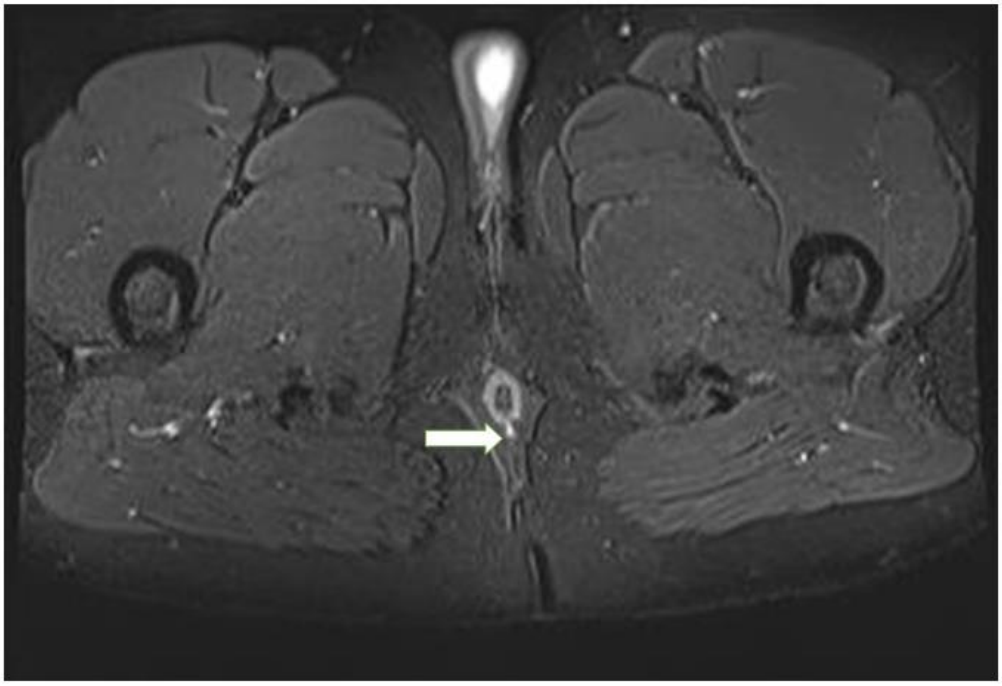
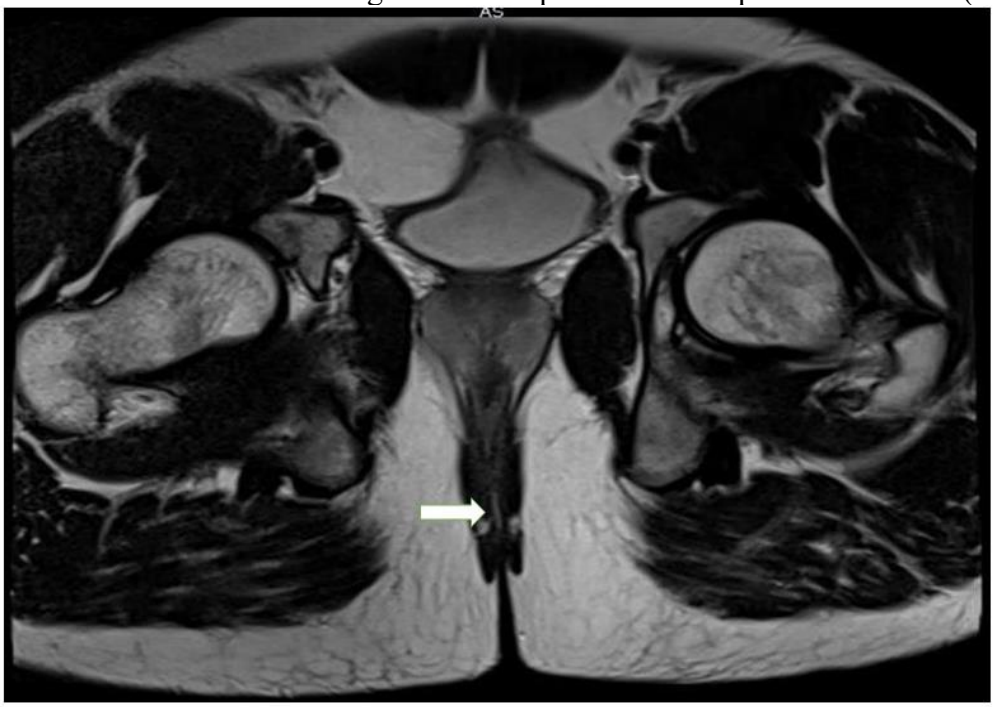


Figure 9: Grade 1: Axial T2W image shows simple linear intersphincteric fistula (arrow).



Grade 2: Intersphincteric with abscess or secondary track. (Figure: 10, 11 and 12)

Figure 10: Grade 2: Axial plane STIR image shows an abscess in left intersphincteric space (asterisk).

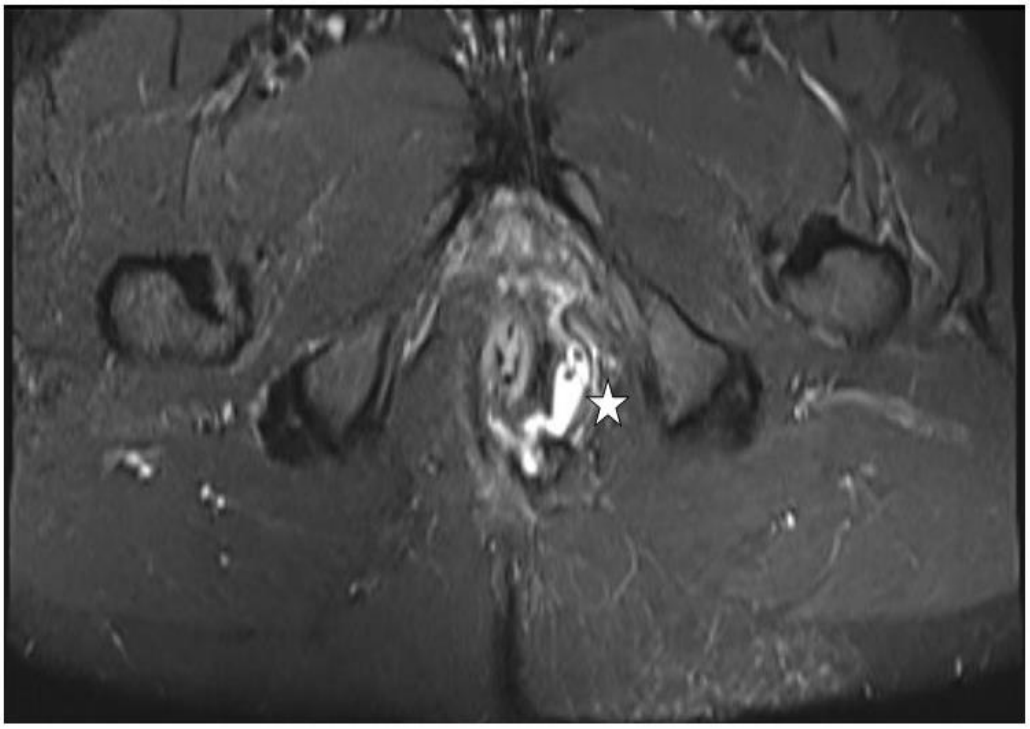


Figure 11: Grade 2: MIP coronal plane shows both intersphincteric tract (arrow) with abscess (asterisk) on left side.

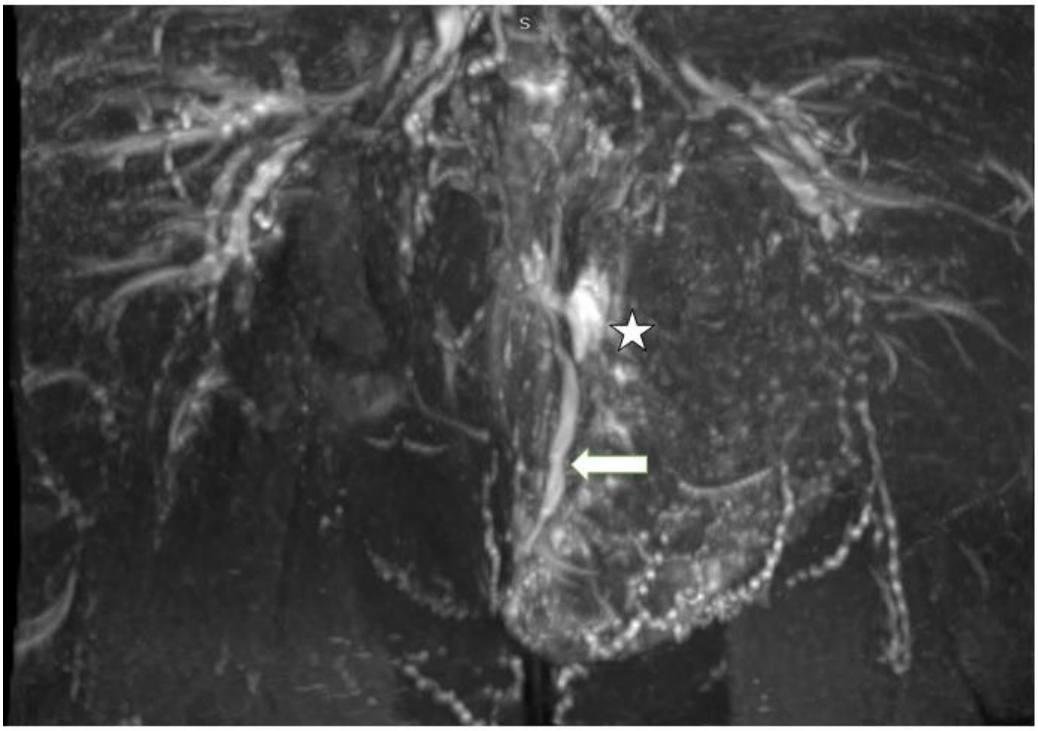
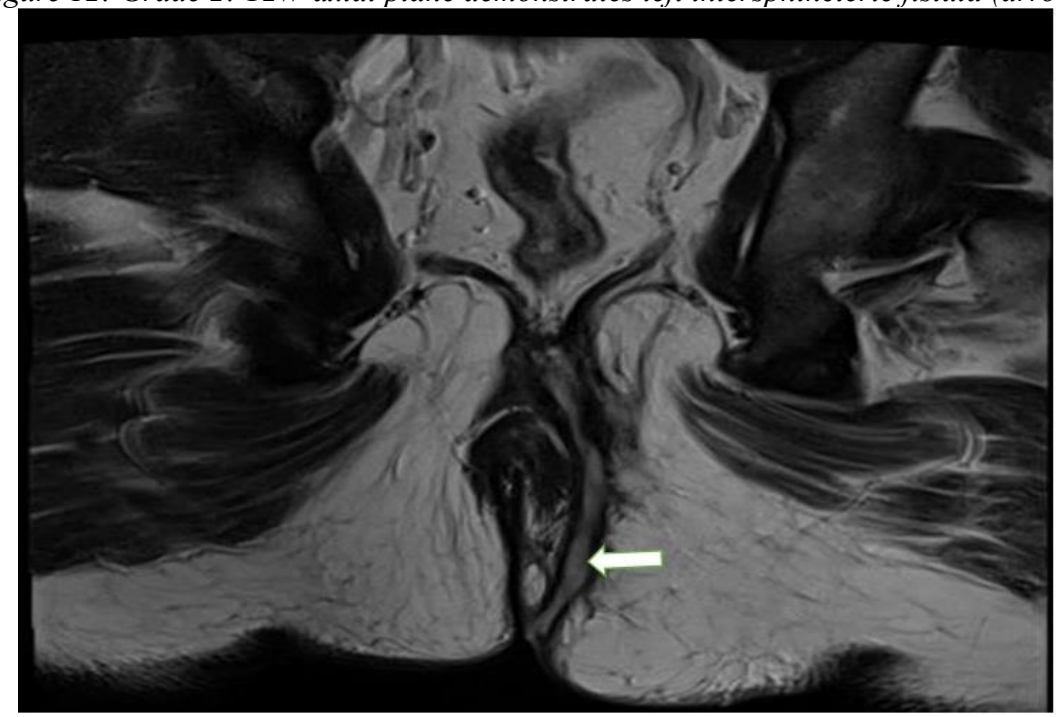


Figure 12: Grade 2: T2W axial plane demonstrates left intersphincteric fistula (arrow).



Grade 3: Transsphincteric fistula. (Figure: 13 and 14)

Figure 13: Grade 3: T2W image coronal plane image shows right transsphincteric fistula (arrow).

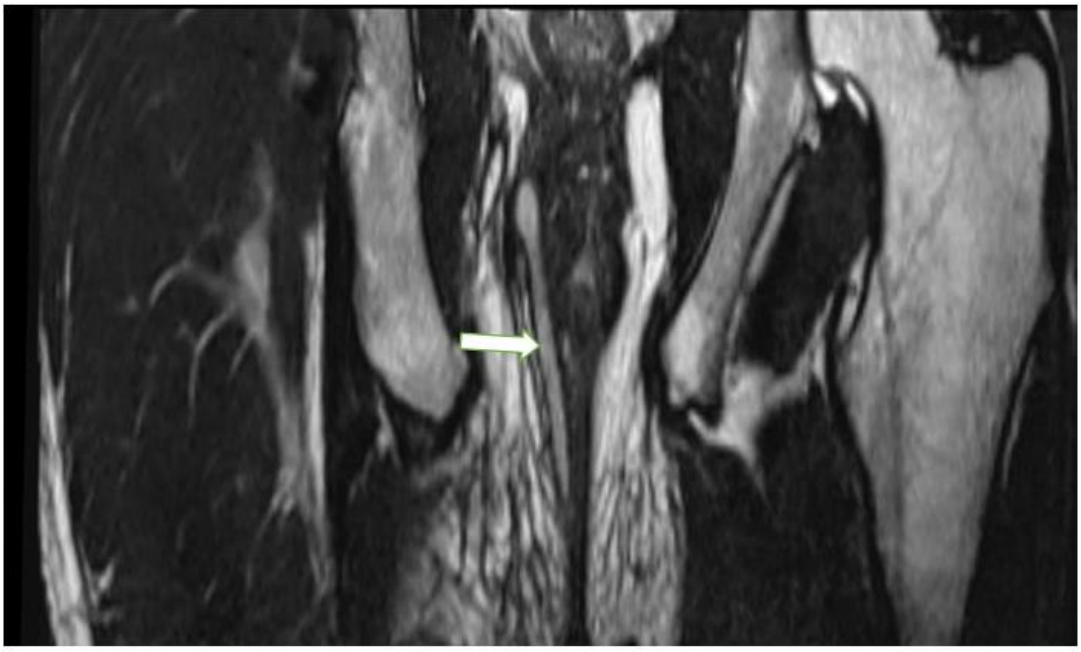
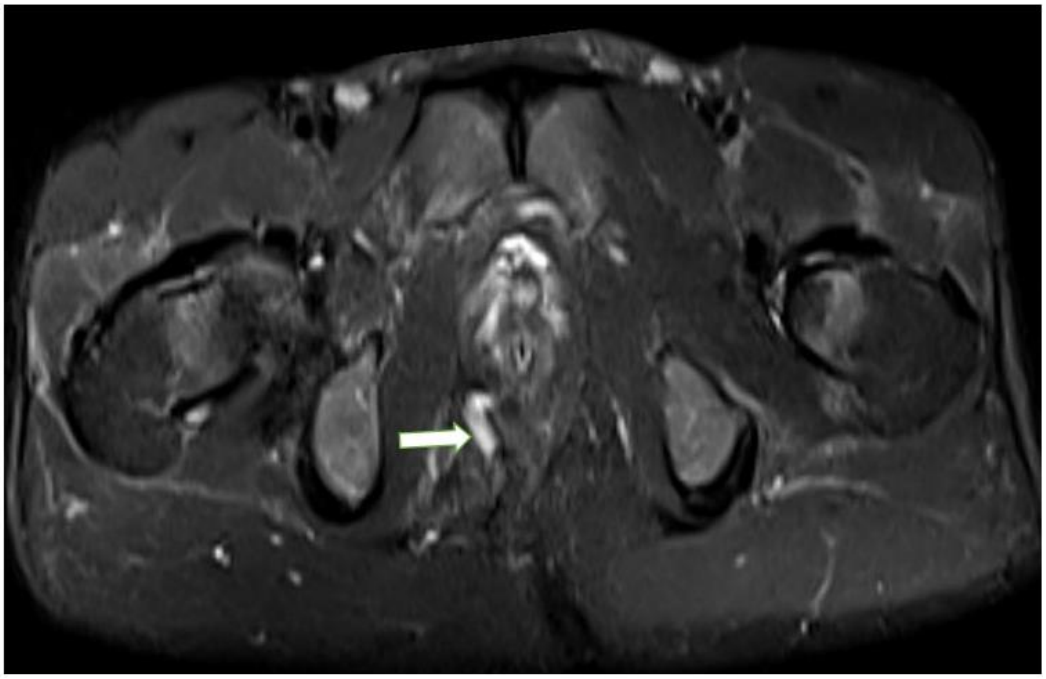


Figure 14: Grade 3: STIR Axial image shows right transsphincteric fistula (arrow).



Grade 4: Transsphincteric fistula with abscess or secondary track in ischioanal or ischiorectal fossa. (Figure: 15, 16 and 17)

Figure 15: Grade 4: T2W sagittal image shows transsphincteric fistula (arrow).

Figure 16: Grade 4: STIR axial plane image shows transsphincteric fistula (arrow).

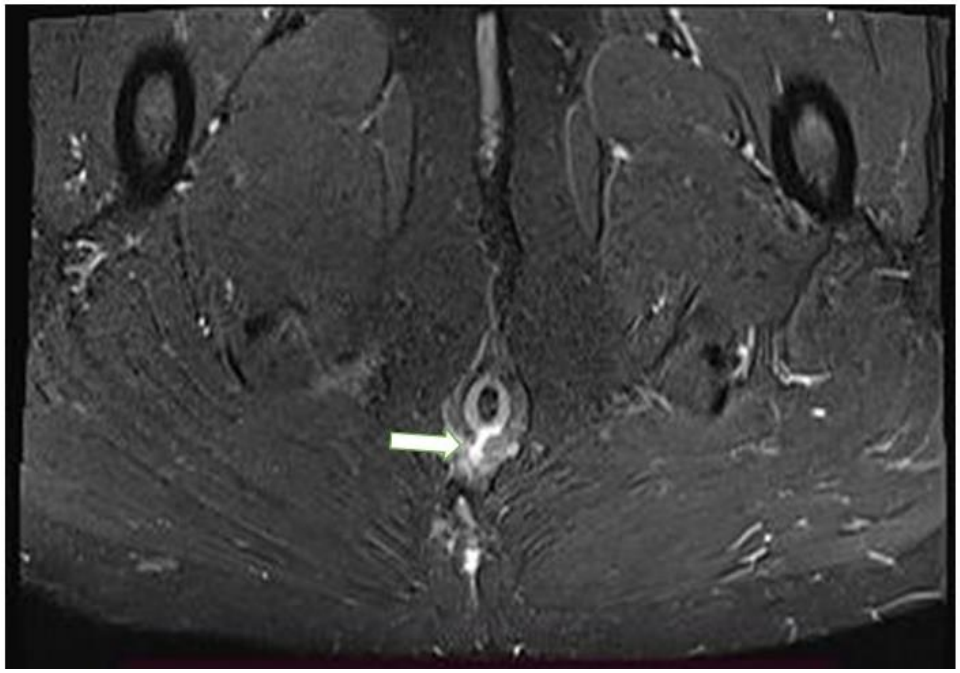
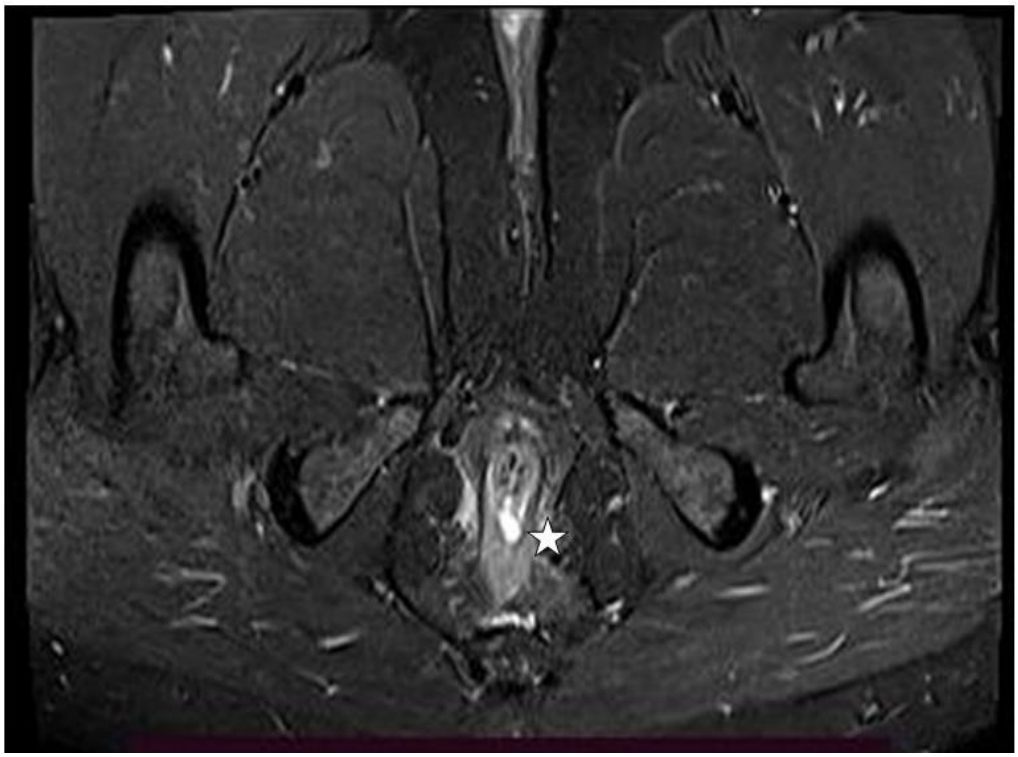


Figure 17: Grade 4: STIR axial image shows abscess in transsphincteric fistula (asterisk).



Grade 5: Supralevator and translevator. (Figure: 18 and 19)

Figure 18: Grade 5: T2W coronal image shows right extrasphincteric fistula(arrow).

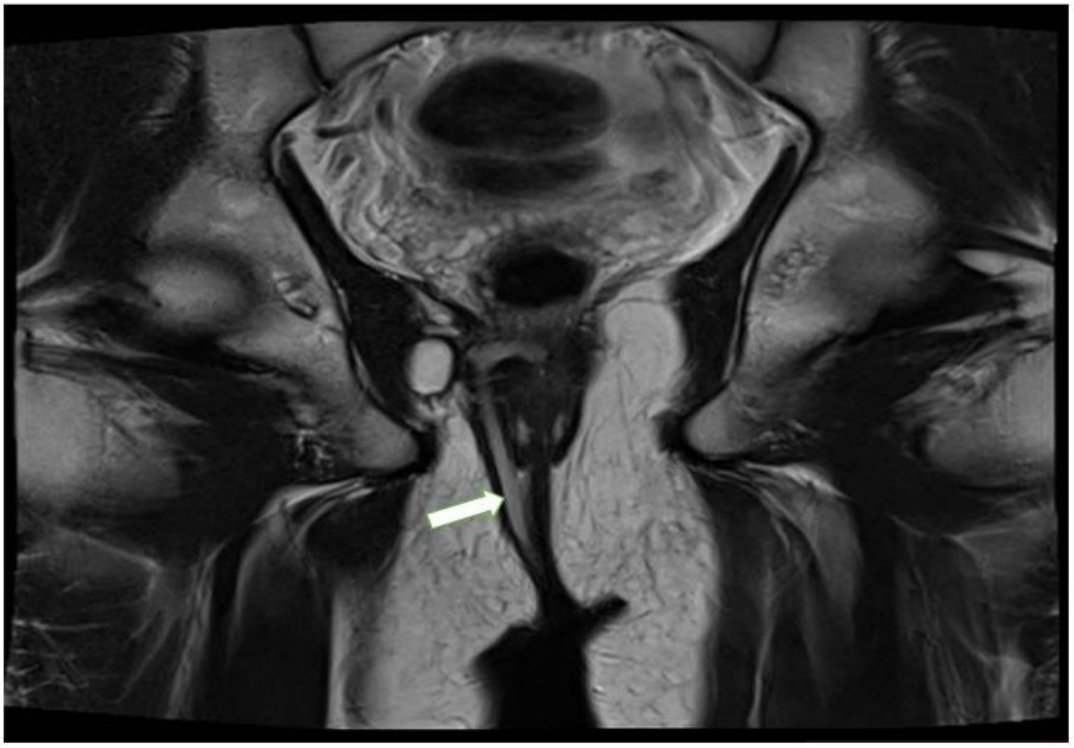


Figure 19: Grade 5: STIR axial image shows right extrasphincteric fistula(arrow).

MRI features of perianal fistulas:

T1 weighted images are perfect for anatomical separation of the sphincter complex, levator plate, and ischiorectal fossa. T2/STIR images illustrates hyperintense fluid within the fistulous tract and hypointense fibrous wall of the fistula. Sphincters and muscles have low signal intensity while active tracks and extensions have high signal intensity on T2 weighted images. Fistulous tracts and active granulation tissue demonstrates intense enhancement whereas any

fluid in the track is hypointense on gadolinium-enhanced fat suppressed T1 weighted images. Chronic fistulous tracts or fibrous scars shows low signal intensity on both T1 and T2 weighted images and there is no enhancement on gadolinium enhancement images. Abscesses are high T2 signal due presence of discharge in the central cavity. Abscesses demonstrate central low signal intensity with ring enhancement on contrast enhanced fat suppressed T1 weighted images.

Review:
MRI of perianal fistula is an excellent and gold standard tool in assessment of fistula-in-ano. MRI gives information about the fistula with good anatomic detail with respect to secondary tracks and abscesses as well as surrounding pelvic organs. MRI helps in the characterisation and preoperative mapping of fistula-in-ano and are major contributors to both preoperative and prognostic value.

3. Results and Discussion:

MRI is highly accurate in identifying fistulous tracts, ramifications, occult collections and their relation to the anal sphincter. MRI adequately monitors the treatment response and helps in differentiating both active and chronic fistulous tracts and also postoperative changes. MRI provides accurate and appropriate information for surgical treatment, reducing the incidence of any possible recurrence and decreasing side effects such as fecal incontinence.

4. Conclusions:

To summarize, our study revealed that MRI is an exquisitely essential test in pre-operative evaluation of the perianal fistula. MRI provides high resolution images depicting anatomy of the anorectal region with accurate depiction of the fistulous tracts and associated secondary abscesses. Thus, it provides with an excellent preoperative understanding of the disease enabling most appropriate surgical treatment and minimizing maximum chances of recurrence. Therefore, it should be highly considered the method of choice for evaluating perianal fistulas.

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