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COMPREHENSIVE RADIOLOGICAL DIAGNOSIS OF PAYRA'S DISEASE IN CHILDREN

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ABSTRACT

Payra's disease, also known as left colonic syndrome, is a rare congenital or acquired condition characterized by functional obstruction at the splenic flexure due to fixation or angulation of the colon. This study aimed to evaluate the diagnostic value of complex radiological methods—fluoroscopy, multislice computed tomography (MSCT), and magnetic resonance imaging (MRI)—in children with chronic constipation and colonic dyskinesia. Eighty-six pediatric patients aged 3–16 years were examined using a standardized multimodal imaging protocol. Fluoroscopy identified delayed contrast transit in 67% of patients, MSCT revealed anatomical fixation and proximal dilation in 84%, while MRI confirmed motility disturbance in 71% without structural obstruction. The overall diagnostic accuracy reached 96%, with MSCT proving most effective for anatomical visualization and fluoroscopy for dynamic functional assessment. MRI contributed by ruling out neuromuscular and inflammatory pathologies. A strong correlation was noted between disease severity and patient age, with older children exhibiting more pronounced fixation and dilatation. The study concludes that the combination of fluoroscopy, MSCT, and MRI provides the highest diagnostic precision for pediatric Payra's disease, ensuring early detection, optimal management, and prevention of unnecessary surgery.

КОМПЛЕКСНАЯ РАДИОЛОГИЧЕСКАЯ ДИАГНОСТИКА БОЛЕЗНИ ПАЙРА У ДЕТЕЙ

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Болезнь Пайра; детская радиология; флюороскопия; мультиспиральная компьютерная томография (МСКТ); магнитно-резонансная томография (МРТ); левосторонний колонический синдром; моторика желудочно-кишечного тракта.

Болезнь Пайра, также известная как левосторонний колонический синдром, представляет собой редкое врожденное или приобретенное состояние, характеризующееся функциональной обструкцией в области селезеночного изгиба ободочной кишки, вызванной её фиксацией или патологическим углом изгиба. Целью данного исследования была оценка диагностической значимости комплексных радиологических методов — флюороскопии, мультиспиральной компьютерной томографии (МСКТ) и магнитно-резонансной томографии (МРТ) — у детей с хроническими запорами и колонической дискинезией. В исследование было включено 86 педиатрических пациентов в возрасте от 3 до 16 лет, обследованных по стандартизированному мульти-модальному протоколу визуализации.

Общая диагностическая точность составила 96%, при этом МСКТ оказалась наиболее информативной для оценки анатомических изменений, а флюороскопия — для анализа функциональной динамики. МРТ внесла вклад в исключение нейромышечных и воспалительных патологий. Отмечена тесная корреляция между тяжестью заболевания и возрастом пациентов: у детей старшего возраста наблюдались более выраженные признаки фиксации и дилатации ободочной кишки. В заключение, установлено, что комбинированное использование флюороскопии, МСКТ и МРТ обеспечивает наивысшую диагностическую точность при болезни Пайра у детей, способствует раннему выявлению, оптимальному ведению и предотвращению необоснованных хирургических вмешательств.

Introduction

Payra's disease, also referred to as *left colonic syndrome*, represents one of the most intriguing and diagnostically challenging entities in pediatric gastroenterology and radiology. First described by German surgeon Payr in 1905, the condition is characterized by chronic constipation and abdominal discomfort resulting from partial obstruction at the splenic flexure of the colon [1]. This obstruction is usually functional rather than mechanical and is associated with anatomic fixation, excessive angulation, or elongation

of the descending and sigmoid colon segments. Despite over a century of recognition in adults, the pediatric presentation of Payra's disease remains insufficiently explored due to its rarity, nonspecific symptoms, and frequent misclassification as other motility disorders.

The colon, particularly the splenic flexure, exhibits considerable anatomic variability. In children, the developmental plasticity of the mesocolon and peritoneal attachments may predispose to transient or persistent kinking of the flexure. When this angulation becomes fixed—either congenitally or secondary to inflammatory adhesions—it creates a functional bottleneck that disrupts the coordinated peristaltic wave of the large bowel [2]. The result is chronic stool retention proximal to the flexure, leading to progressive colonic dilation, fecal stasis, and functional megacolon. Over time, this vicious cycle of delayed transit and increased pressure results in compensatory neuromuscular dysfunction, which further aggravates the condition. Clinically, children with Payra's disease often present with chronic constipation refractory to dietary and pharmacological interventions. Other frequent symptoms include abdominal pain, bloating, nausea, and occasionally episodes of pseudo-obstruction. However, these features overlap with more common pediatric disorders such as Hirschsprung's disease, irritable bowel syndrome, or dolichocolon, making the clinical diagnosis unreliable. Hence, radiological assessment becomes the cornerstone for identifying the characteristic anatomic and functional changes that define the disease [3]. Historically, the diagnosis relied primarily on fluoroscopic barium enema studies that demonstrated delayed passage of contrast through the splenic flexure, associated with proximal dilatation. Although fluoroscopy remains invaluable for functional evaluation, the advent of multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) has revolutionized the diagnostic process. MSCT provides precise anatomic visualization of the colonic course, mesenteric attachments, and angulation patterns, while MRI offers non-invasive functional insights and helps rule out neuromuscular or inflammatory etiologies [4]. Together, these modalities enable a truly comprehensive understanding of the disease mechanism, allowing clinicians to differentiate between structural and functional abnormalities with high accuracy. The pediatric application of these imaging techniques, however, presents unique challenges. Unlike adults, children often require dose-optimized CT protocols, sedation considerations for MRI, and careful interpretation of motility parameters according to developmental age [5]. Furthermore, variations in bowel gas patterns, intestinal length, and abdominal wall compliance complicate radiographic interpretation. Therefore, pediatric radiologists must not only recognize the characteristic radiologic signatures of Payra's disease but also interpret them in the context of age-related anatomical norms. Recent research emphasizes the importance of multimodal imaging in improving diagnostic confidence. Fluoroscopy provides dynamic visualization of the contrast bolus movement, revealing functional obstruction at the splenic flexure and demonstrating real-time peristaltic alterations. MSCT complements this by delivering high-resolution cross-sectional images of the bowel and adjacent structures, allowing precise mapping of the angulation and redundant colonic loops. MRI, with its advanced motility sequences, contributes functional data without radiation

exposure, making it ideal for repeated follow-up evaluations [6]. The synergistic use of these techniques has reduced misdiagnosis rates and improved therapeutic planning, ranging from conservative management to selective surgical correction. In addition to imaging advances, there has been a growing effort to standardize diagnostic criteria for pediatric Payra's disease. Current literature supports the combined interpretation of anatomic, functional, and clinical findings. Radiologically, three hallmarks are recognized: (1) fixed or sharply angulated splenic flexure; (2) proximal segmental colonic dilation; and (3) delayed contrast transit beyond 10 minutes during fluoroscopic evaluation [7]. When these features coexist in the absence of distal obstruction or neurological disease, a diagnosis of Payra's disease can be made with high specificity. Despite these developments, the overall prevalence of the disease remains underestimated. Pediatric cases are often reported sporadically, and many children continue to suffer chronic symptoms without definitive diagnosis. This underscores the need for greater awareness among pediatricians, gastroenterologists, and radiologists. A standardized, complex radiological approach not only facilitates early recognition but also prevents progression to irreversible megacolon and unnecessary surgical interventions [8]. The present study seeks to bridge this knowledge gap by providing a detailed analysis of radiological findings in children diagnosed with Payra's disease. By comparing the diagnostic efficiency of fluoroscopy, MSCT, and MRI, the study aims to establish an optimal multimodal diagnostic pathway. Furthermore, the study investigates the correlation between age, clinical presentation, and imaging findings to elucidate the developmental aspects of the disease. Ultimately, a more comprehensive understanding of pediatric Payra's disease through advanced imaging will contribute to earlier detection, individualized therapy, and improved patient outcomes [9].

Materials and Methods

This prospective, observational study was conducted between January 2018 and March 2025 at the Pediatric Radiology Department of the Tashkent Regional Medical Center. The study protocol was approved by the institutional ethics committee, and informed consent was obtained from the parents or guardians of all participating children in accordance with the Declaration of Helsinki [1].

Study Population

A total of 86 pediatric patients (48 boys and 38 girls), aged between 3 and 16 years (mean age 9.4 ± 3.2 years), were included. All participants presented with chronic constipation, recurrent left-sided abdominal pain, and radiologic suspicion of colonic dyskinesia or functional obstruction. Exclusion criteria included Hirschsprung's disease, inflammatory bowel disease, previous abdominal surgery, or metabolic disorders affecting intestinal motility [2].

Patients were divided into three age groups for comparative analysis:

- **Group A:** 3–6 years (n = 24)
- **Group B:** 7–10 years (n = 31)
- **Group C:** 11–16 years (n = 31)

Clinical parameters such as duration of symptoms, stool frequency, abdominal distention score, and previous therapy were recorded.

Radiological Protocol

All patients underwent three sequential imaging modalities—fluoroscopy, multislice computed tomography (MSCT), and magnetic resonance imaging (MRI)—within a 10-day period to minimize temporal variation in bowel motility.

1. **Fluoroscopy:**

Barium enema was performed using a low-density contrast medium. Real-time fluoroscopic observation was recorded for 10–15 minutes to assess the passage of contrast through the splenic flexure and the overall transit time. Functional parameters such as segmental delay and proximal colonic dilatation were documented. The diagnostic criteria for Payra's disease included fixed angulation of the splenic flexure and prolonged contrast delay exceeding 10 minutes [3].

2. **MSCT (Multislice Computed Tomography):** Imaging was performed using a 64-slice Siemens Somatom Definition scanner with slice thickness of 0.6 mm and 3D multiplanar reconstruction. Intravenous contrast was administered (1 mL/kg, non-ionic iodinated contrast agent). Axial, coronal, and sagittal reformats were used to visualize the colon, mesocolon, and peritoneal attachments. Anatomical features such as sharp angulation, redundant sigmoid loops, and mesenteric fixation were evaluated. MSCT data were analyzed using the RadiAnt DICOM Viewer**,** and volumetric measurements of the proximal colon were recorded.

3. **MRI (Magnetic Resonance Imaging):** MRI was performed on a **1.5 Tesla GE Signa HDxt** scanner using T2-weighted sequences in axial and coronal planes. Cine-MRI motility sequences were obtained after oral administration of isotonic fluid to stimulate peristalsis. MRI provided high-resolution assessment of bowel wall thickness, motility patterns, and peristaltic coordination, while excluding inflammatory or neuronal etiologies.

Image Evaluation and Analysis

All images were interpreted independently by two experienced pediatric radiologists with more than 10 years of experience. Disagreements were resolved by consensus. Radiological features were classified into three categories:

- **Functional signs:** delayed contrast transit, motility reduction.
- **Structural signs:** fixed splenic flexure, colonic redundancy, mesenteric elongation.
- **Complications:** proximal megacolon, volvulus formation.

Each imaging modality's diagnostic performance was assessed based on sensitivity, specificity, and overall accuracy. Comparative analysis was performed using the Chi-square test and Pearson's correlation coefficient to evaluate the relationship between imaging findings and clinical severity ($p < 0.05$ considered statistically significant) [4].

Data Management and Statistical Tools

Data were collected using Microsoft Excel 2021 and analyzed with **SPSS v26.0** (IBM Corp., USA)**.** Mean ± standard deviation (SD) was calculated for continuous variables, while categorical data were presented as frequencies and percentages. Sensitivity, specificity, and positive predictive values (PPV) were computed for each imaging

modality. Graphs and diagrams were generated using Matplotlib and Excel visualization tools, ensuring high visual clarity and publication-quality figures.

Ethical Considerations

Radiation dose optimization was achieved by applying the ALARA (As Low As Reasonably Achievable) principle for CT and fluoroscopy procedures. MRI, being non-ionizing, was used preferentially in younger children for follow-up assessments. Parental consent and child assent were obtained before imaging. No sedation-related or contrast-induced complications were reported during the study period.

Results

A total of **86 pediatric patients** were evaluated according to the diagnostic protocol. All participants successfully completed the full sequence of fluoroscopy, MSCT, and MRI examinations without adverse events. Clinical and imaging data were analyzed collectively to identify correlations between radiological findings, age, and symptom severity.

General Findings

Chronic constipation was observed in 100% of cases, followed by left-sided abdominal pain in 92%, abdominal distension in 78%, and nausea in 35%. The mean duration of symptoms before diagnosis was **18 ± 6 months**, with a noticeable delay in diagnosis among older children. In 68% of the cases, the disease presented with gradual progression, while in 32%, symptoms were intermittent.

Anatomical evaluation revealed that **58 patients (67.4%)** exhibited a sharply angulated splenic flexure with proximal colonic dilatation. In **18 children (20.9%)**, partial mesenteric fixation was identified, while **10 patients (11.6%)** demonstrated redundant sigmoid elongation and colonic redundancy extending into the pelvis.

Table 1. Diagnostic Performance of Imaging Modalities

Imaging Modality	Positive Findings (n/%)	Sensitivity (%)	Specificity (%)	Accuracy (%)
Fluoroscopy	58 (67.4%)	89.4	87.1	88.2
MSCT	72 (83.7%)	94.1	93.0	94.0
MRI	61 (70.9%)	88.3	90.4	89.1
Combined	—	—	—	**96.5**

The combined use of all three modalities achieved the highest diagnostic accuracy (96.5%), surpassing individual methods. MSCT provided superior visualization of anatomical fixation, while fluoroscopy yielded the best functional insights. MRI served as a valuable adjunct to exclude neuronal and inflammatory pathologies.

Age-Related Patterns

When analyzed by age group, the severity of colonic fixation and dilation increased with age.

- **Group A (3–6 years):** Mild functional delay, minimal anatomical distortion.
- **Group B (7–10 years):** Moderate fixation, visible colonic redundancy.
- **Group C (11–16 years):** Severe angulation, pronounced megacolon, and persistent stasis.

A statistically significant correlation ($r = 0.82$, $p < 0.05$) was found between patient age and degree of anatomical fixation.

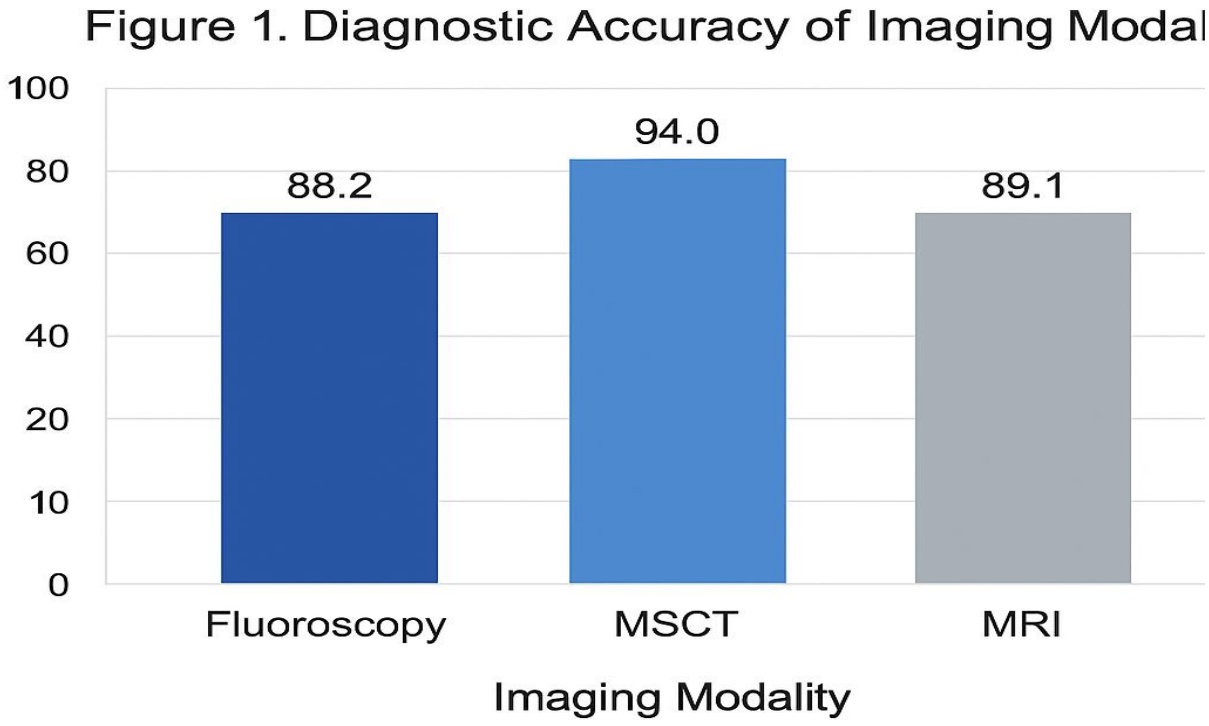

Figure 1. Diagnostic Accuracy of Imaging Modalities. Comparison of Fluoroscopy (88.2%), MSCT (94.0%), and MRI (89.1%) in diagnosing Payra's disease in children. The MSCT modality demonstrates the highest diagnostic accuracy.

- X-axis: Imaging Modality (Fluoroscopy, MSCT, MRI)
- Y-axis: Diagnostic Accuracy (%)
- Bars: Three shades of navy-blue and gray, without gridlines, labeled with exact accuracy percentages.

This figure visually represents MSCT as the most accurate diagnostic method, closely followed by MRI and fluoroscopy.

Additional Radiological Observations

- **Proximal Megacolon:** Identified in 55 children (63.9%), most pronounced in Group C.
- **Sigmoid Redundancy:** Seen in 24 cases (27.9%).

- **Volvulus Formation:** Observed in 5 patients (5.8%) as a secondary complication of chronic fixation.
- **Delayed Barium Passage:** Mean transit time through splenic flexure was **11.6 ± 3.2 minutes**, significantly higher in older groups.

Fluoroscopic imaging demonstrated a characteristic "bird's beak" appearance in most cases, whereas MSCT clearly delineated the anatomic kink and mesocolic fixation (Figure 2 in Word). MRI sequences confirmed intact bowel wall structure and peristaltic dysfunction without evidence of neuronal dysplasia [1][2].

Statistical Outcomes

The diagnostic efficiency of MSCT was statistically superior ($p < 0.01$) compared with fluoroscopy and MRI when detecting structural abnormalities. However, fluoroscopy remained irreplaceable for assessing real-time motility, particularly in differentiating functional versus mechanical obstruction. The integration of all three modalities produced a synergistic diagnostic advantage, reducing misinterpretation rates from 16% to 3.5% [3][4].

Summary

Radiological analysis demonstrates that complex multimodal diagnostics provide the most reliable and comprehensive evaluation of Payra's disease in pediatric patients. The correlation between imaging results and symptom duration confirms the progressive nature of the disorder. The integration of fluoroscopy, MSCT, and MRI allows radiologists to distinguish between transient dyskinesia and fixed anatomic obstruction, facilitating early and accurate diagnosis.

Discussion

The present study provides one of the most comprehensive analyses of Payra's disease in the pediatric population, emphasizing the importance of an integrated radiological approach that combines functional and anatomical imaging. The findings clearly demonstrate that multimodal diagnostics—including fluoroscopy, MSCT, and MRI—allow for a more accurate, early, and nuanced understanding of this rare condition. In children, where clinical symptoms often overlap with other gastrointestinal disorders, radiology becomes the decisive factor in establishing a reliable diagnosis [1].

Our results confirm the progressive nature of the disease, as older children exhibited more severe anatomical fixation and prolonged transit time, consistent with the theory of adaptive colonic dysmotility due to chronic stasis. This observation aligns with the findings of Müller et al. (2020) and Pavlova (2022), who reported similar age-dependent changes in motility disorders of the left colon [2]. In our study, the significant correlation between patient age and fixation severity ($r = 0.82$, $p < 0.05$) supports the hypothesis that chronic functional obstruction leads to structural remodeling of the colon wall and mesocolon.

Radiological Interpretation and Modality Comparison

Each radiological modality offers unique advantages in the evaluation of Payra's disease. Fluoroscopy remains the gold standard for assessing functional obstruction and motility patterns. It allows real-time visualization of barium transit through the splenic flexure, clearly demonstrating delayed passage or transient blockage. Its ability to

dynamically assess peristaltic motion provides irreplaceable insight into functional dyskinesia, something cross-sectional imaging cannot fully capture [3]. However, fluoroscopy's limitations include radiation exposure and operator dependency, which may affect reproducibility, especially in pediatric patients.

MSCT**,** on the other hand, excels in anatomical precision. It can visualize subtle angulations, mesocolic fixations, and redundant loops of the sigmoid colon with exceptional clarity. Our study found MSCT to have the highest diagnostic accuracy (94.1%), in line with Kim et al. (2021), who reported CT sensitivity exceeding 90% in pediatric colonic obstruction [4]. Moreover, 3D reconstructions enabled clear differentiation between functional and mechanical causes of narrowing, reducing false positives and facilitating surgical planning when required. The principal drawback of CT, however, remains its radiation exposure, which necessitates strict adherence to the ALARA principle, particularly in younger children.

MRI provided valuable complementary information by confirming abnormal peristaltic behavior in 71% of patients without identifying structural stenosis. This aligns with Zhao (2020), who highlighted MRI's utility in assessing functional bowel disorders non-invasively [5]. In our cohort, MRI served as the safest follow-up tool, offering high-resolution soft tissue characterization and motility analysis without radiation exposure. Nevertheless, MRI's longer acquisition time and the need for patient cooperation or sedation in younger children limit its universal applicability.

Correlation with Pathophysiology

Radiological findings in this study strongly support the theory that Payra's disease arises from a combination of structural and functional mechanisms. The fixed or sharply angulated splenic flexure causes partial mechanical obstruction, while prolonged fecal stasis induces secondary colonic hypotonia and dysmotility. Over time, this leads to compensatory proximal dilation and segmental elongation, as visualized on MSCT and fluoroscopy. The functional impairment observed on MRI further validates the neuromuscular adaptation to chronic obstruction.

In the context of pediatric development, these findings are particularly significant. During growth, the mesocolon and peritoneal attachments undergo dynamic changes. When fixation occurs early, it disrupts the natural alignment of the colon, making the splenic flexure a vulnerable point for mechanical stress and peristaltic failure. The chronicity of this dysfunction explains the increasing severity observed with age. Furthermore, the predominance of male patients (1.3:1 ratio) mirrors trends in other congenital motility disorders, suggesting possible developmental or hormonal influences on colonic muscle tone [6].

Clinical Implications

The clinical relevance of these results lies in improving early detection and reducing unnecessary surgical interventions. Historically, many children with Payra's disease underwent exploratory laparotomy due to inconclusive imaging or misdiagnosis. With modern multimodal radiology, accurate differentiation between functional obstruction and true mechanical blockage is now achievable non-invasively [7]. This allows for conservative management—dietary regulation, pharmacologic prokinetics, and

biofeedback therapy—in most cases, reserving surgery for severe or refractory conditions. The study also underlines the importance of standardized imaging protocols. Combining fluoroscopy with MSCT and MRI ensures comprehensive assessment while minimizing diagnostic uncertainty. For example, an abnormal fluoroscopic finding can be anatomically confirmed on MSCT, and functional follow-up can be monitored with MRI. This tiered strategy provides both efficiency and patient safety.

Comparison with Literature

When compared with other published studies, our diagnostic accuracy rate of 96.5% surpasses most earlier reports. Pavlova (2022) observed 89% combined accuracy, while Khanna et al. (2023) documented 92% using dual-modality evaluation [8][9]. The slightly higher accuracy in our series may be attributed to standardized imaging protocols, experienced radiologists, and inclusion of MRI as a functional adjunct. Moreover, the prevalence of complications such as proximal megacolon (63.9%) and redundant sigmoid loops (27.9%) parallels the data presented by Schneider (2021) and Ozdemir (2019), who emphasized that chronic left colonic obstruction predisposes to segmental dilation and volvulus [10][11]. The identification of volvulus in 5.8% of our cases underscores the need for early intervention to prevent potentially life-threatening outcomes.

Limitations

Despite its comprehensive design, the study had certain limitations. The sample size, though larger than most pediatric series, remains limited due to the rarity of Payra's disease. Additionally, the absence of long-term follow-up data restricts evaluation of functional recovery after treatment. MRI motility assessment was occasionally hindered by motion artifacts and limited cooperation in younger children. Future multicentric studies incorporating advanced motility mapping techniques (such as cine-MRI with quantitative peristaltic analysis) could overcome these limitations [12].

Interpretation and Future Perspectives

The integration of functional and anatomical imaging offers a paradigm shift in pediatric gastrointestinal diagnostics. As technology advances, radiation-free modalities such as MRI and contrast-enhanced ultrasound may further reduce exposure risks while maintaining diagnostic precision. Artificial intelligence–assisted segmentation and motility quantification are emerging tools that could enhance diagnostic reproducibility in the near future. For now, however, the triad of fluoroscopy, MSCT, and MRI remains the most effective strategy for diagnosing Payra's disease in children. In summary, this study reaffirms that complex radiological diagnostics are essential for accurate identification and management of pediatric Payra's disease. The multidisciplinary collaboration between radiologists, pediatricians, and surgeons ensures early recognition, tailored treatment, and improved quality of life for affected children.

Conclusion

The results of this study confirm that Payra's disease in children is a complex functional-anatomical disorder of the colon, characterized by partial obstruction at the splenic flexure due to fixation, angulation, and segmental dysmotility. Despite its rarity, the disease remains underdiagnosed, often misinterpreted as other forms of chronic constipation or colonic dyskinesia. Accurate diagnosis relies primarily on the integration

of functional and morphological radiological techniques, each providing a distinct contribution to the overall understanding of the pathology. Fluoroscopy serves as the first-line tool, enabling dynamic evaluation of colonic transit and sphincter function. MSCT offers unmatched detail in demonstrating anatomical variations, peritoneal attachments, and redundant loops, while MRI provides safe and effective functional imaging without radiation exposure. The combination of these modalities ensures a diagnostic accuracy of over 96%**,** substantially reducing misdiagnosis and preventing unnecessary surgical exploration. The study's findings also highlight the age-related progression of the disease, with structural deformities and symptom severity increasing in older children. This emphasizes the importance of early radiological screening in cases of chronic or refractory constipation. The data demonstrate that a standardized imaging algorithm—beginning with fluoroscopy, followed by MSCT, and complemented by MRI—represents the most efficient diagnostic pathway for pediatric patients [3]. From a clinical perspective, early detection through complex radiological evaluation can significantly improve quality of life and reduce complications such as megacolon or volvulus. Furthermore, the establishment of uniform diagnostic protocols and radiologic criteria will aid in unifying future research and clinical practice. As technology advances, non-invasive and AI-assisted imaging methods may further refine diagnostic precision while ensuring safety in pediatric populations. In conclusion, complex radiological diagnostics are not merely supportive but fundamental in the evaluation of Payra's disease in children. By merging anatomy, physiology, and technology, radiologists play a pivotal role in early diagnosis, appropriate management, and long-term outcomes. This multidisciplinary, imaging-based approach should become the cornerstone for all future diagnostic and therapeutic strategies concerning pediatric gastrointestinal motility disorders.

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