# Computed Tomography findings of Intersigmoid Hernia

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# Abstract

## Purpose

To evaluate the computed tomography findings of intersigmoid hernias.

## Methods

Between April 2010 and March 2018, seven patients who were surgically diagnosed with intersigmoid hernia from three institutions were enrolled in this study. Two radiologists evaluated imaging findings for the herniated small bowel, the distance between the occlusion point and bifurcation of the left common iliac artery, and its relationships with the surrounding structures.

## Results

All patients were male ,and their mean age (standard deviation, range) was 61.0 (13.5, 36–85) years. The mean size of the bowel loops was 5.19 (1.34, 4.0-8.3) cm in the caudal direction, 3.59 (0.79, 2.5–5.1) cm in the lateral, and 3.43 (0.64, 2.5–4.7) cm in the anterior-posterior direction, 37.88 (27.79, 15.6–103.0) $cm^3$ calculated by the length. The obstruction point was located 3.57 (0.59, 2.84–4.70) cm inferior to the bifurcation of the left common iliac artery. In all cases, the small bowel ran under the point that the inferior mesenteric vessels bifurcated to the superior rectal vessels and the sigmoid vessels and formed a sac-like appearance between the left psoas muscle and the sigmoid colon. The ureter ran dorsal to the point of the bowel stenosis, and the left gonadal vein outside the small bowel loops.

## Conclusion

In all cases, the small bowel ran under the position of the inferior mesenteric vessel's bifurcation and became strangulated at the anterior of the left ureter, showing a sac-like appearance medial to the left gonadal vein. These findings may be characteristic of the intersigmoid hernia.


# Introduction

An internal hernia is defined as the protrusion of the abdominal viscera through a peritoneal or mesenteric aperture into a compartment in the abdominal and pelvic cavities [1, 2]. It is reported to cause 0.6–5.8% of acute small bowel obstruction [3].

A sigmoid mesocolon-related internal hernia is a rare type of internal hernia that accounts for 6% of internal hernias [2]. Historically, Benson and Killen [4] classified sigmoid mesocolon-related hernias into three subtypes: intersigmoid hernia, intramesosigmoid hernia, and transmesosigmoid hernia. Intersigmoid hernia (ISH) was defined as the herniation of bowel loops into the intersigmoid fossa (ISF).

ISH has been reported as the most or the second most frequent type of sigmoid mesocolon-related internal hernia [4, 5]. ISH is treated with surgery, but preoperative diagnosis is difficult because of the few of specific clinical and radiological findings [5, 6]. CT is an important diagnostic tool for internal hernias [7], but the CT findings of ISH has been few reported and most of them were single case reports or review article [5, 8]. Thus, we evaluated the CT findings of seven patients who were surgically diagnosed with intersigmoid hernia.

# Materials And Methods

Patient Population

After obtaining institutional review board approval from all three institutions, we searched for patients suspected of having intersigmoid hernia from their radiology reporting databases between April 2010 and March 2018. Nine patients were initially included. Two were excluded because of a lack of surgical confirmation of diagnosis. Finally, seven patients were enrolled in this study.

CT technique

All CT examinations were performed with a 4- to 64-detector row helical CT scanner (Asteion 4; Toshiba Medical Systems, Aquillion 64; Toshiba Medical Systems, Light Speed VCT; GE, light speed 32; GE). One patient underwent only an unenhanced CT scan. Others underwent both unenhanced and enhanced CT scans, either single-phase (n = 2) or biphasic (n = 4). About 100 ml of nonionic intravenous contrast medium (iohexol [300 mgI/ml], iopamidol [300 mgI/ml], iopamidol [370 mgI/ml]) were administered at a rate of 3 ml/sec (biphasic) or 2 ml/sec (single-phase). Biphasic CT scans were performed at 40- and 80-sec delay (n = 2) or 40 and 110-sec delay (n = 3). Two patients underwent a single-phase CT scan with a 180-sec delay. All cases were reconstructed in the axial and coronal planes. The slice thickness was 1–7 mm in the axial plane and 3–5 mm in the coronal plane.

Qualitative and Quantitative analysis

All CT images were reviewed by two radiologists (one had six years of experience in abdominal imaging and another 21 years of experience in abdominal imaging). Both quantitative and qualitative evaluations were performed separately by the two radiologists. If there was disagreement between the two opinions, we discussed and integrated the opinions. To estimate the size of the ISF, we measured the size of the strangulated small bowel loop in the lateral and anterior-posterior length at the largest section of the axial plane and the caudal-cranial length at the largest section of the coronal plane (Fig. 1). For estimating the location of the orifice of ISF, the vertical distance between the bowel occlusion point and bifurcation of the left common iliac artery in the coronal plane was also measured (Fig. 2). We also estimated the volume of ISF using the formula for the volume of an ellipse (V = lateral length × anterior-posterior length × caudal-cranial length × 3.14 × 1/6).

The positional relationships between the bowel loop or obstructive point and the surrounding structures (superior sigmoid vessels, sigmoid vessels, sigmoid colon, left psoas muscle, left gonadal vein, and left ureter) were evaluated.

# Results

All cases were male, and the mean age (standard deviation, range) was 61.0 (13.1, 36–85) years. There was no intestinal necrosis in all cases, and the patient was treated with release of the incarcerated bowel. The mean size of the bowel loops (standard deviation, range) was 5.19 (1.34, 4.0-8.3) cm in the caudal direction, 3.59 (0.79, 2.5–5.1) cm in the lateral, and 3.43 (0.64, 2.5–4.7) cm in the anterior-posterior direction. The mean volume of ISF was 37.88 (27.79, 18.34-103.04) cm3. The point of obstruction of the small bowel was located inferior to the bifurcation of the left common iliac artery and was 3.57 (0.59, 2.8–4.7) cm caudal. (Table 1)

In all cases, the small bowel ran under the point that the inferior mesenteric vessels bifurcated to the superior rectal vessels and the sigmoid vessels. It formed a sac-like appearance between the left psoas muscle and the sigmoid colon (Fig. 3). In addition, the ureter ran dorsal to the point of the bowel stenosis, and the left gonadal vein ran outside the small bowel loops (Fig. 4).

# Discussion

Intersigmoid hernia (ISH) is the herniation of the small bowel into the intersigmoid fossa [4]. CT plays an important role in the diagnosis of internal hernias, including ISH. The diagnosis of internal hernia with CT images consists of identifying the sac-like appearance of the strangulated small intestine and the causative congenital structures on the surrounding vasculature and organs [8–11]. A sac-like appearance is a direct sign of a closed-loop obstruction. This means a fluid-filled, distended intestinal loop or a radial array of distended loops with stretched and thickened mesenteric vessels converging to a central point [8, 11]. The CT findings of ISH have already been reported as an entrapped small bowel that shows a sac-like appearance between the stretched sigmoid colon and the left psoas muscle [5, 6]. However, to the best of our knowledge, no studies have investigated the CT findings in multiple ISH cases.

In this study, we evaluated the CT findings of seven intersigmoid hernia cases and found the following findings in all cases: The small bowel (a) ran under the point that the inferior mesenteric vessels bifurcated to the superior rectal vessels and the sigmoid vessels (Fig. 3, 5a), (b) was strangulated at the anterior of the left ureter (Fig. 4, 5b), (c) formed a sac-like appearance (d) medial to the gonadal vein (Fig. 4, 5b), and (e) lay between the left psoas muscle and the sigmoid colon (Fig. 4, 5b). Among these findings, (c) and (e) are consistent with previous reports. Because the ISH is the only internal hernia that related to the intersigmoid fossa, the remaining findings (a, b, d) will be discussed based on the anatomy of the intersigmoid fossa.

The intersigmoid fossa (ISF) is present in 50–80% of autopsies with no difference between sexes [12]. It is an inverted V-shaped cul-de-sac situated at the top of the two roots of the parietal brim of the sigmoid mesocolon and is formed by a defect of fusion between the mesentery and the parietal peritoneum, so its space is enclosed by both structures [12]. The orifice points downward and slightly to the left [12, 13]. Some structures surround the orifice of ISF; dorsal to the orifice is either the left common iliac artery or two branches of bifurcation (left internal or external iliac artery) and ureter, and above it is the superior rectal artery and the sigmoid arteries [13]. Somé et al. reported that the most frequently encountered structures during the dissection of the ISF fundus were the ureter, the common iliac artery, gonadal pedicle, and the left external iliac artery [12].

As for the finding in (a) and (b) above, it is consistent with the description that the ureter was situated dorsal to the orifice and the superior rectal artery and the sigmoid arteries above [13]. As for (d), there is a description of the gonadal pedicle running backward to the ISF fundus [12], but we could not find any report of it running laterally to the ISF. This anatomical positioning is assumed to be related to embryological mechanisms, but we could not find any reports that discussed this.

Despite no sex differentiation in the presence of ISF [12], all patients were male. In females, the uterus may inhibit the protrusion of the small bowel into the ISF because of its position. The ISF is located near the ovarian fossa, which is surrounded posteriorly by the ureter and the internal iliac artery, superiorly by the external iliac artery [14]. Therefore, the left ovary may prevent small bowel protrusion. These anatomical features may explain the sex differentiation of the presence of ISH in this study.

We evaluated the size of the ISF by measuring the diameter of the small bowel loop. In all cases, the diameter in the craniocaudal direction was the longest, and the diameters in the lateral and anterior-posterior directions were comparable. Chiarini et al. [6] and Somé et al. [12] reported the size of ISF in previous studies. Chiarini et al. reviewed 114 studies of ISH and reported that the mean size of ISF in 96 patients with ISH was 2.65 cm (SD 1.15 cm, range 1–10 cm). Somé et al. measured the size of orifice (transverse and longitudinal diameter, TD, and LD) and depth of fossa in 48 cases of cadavers and calculated the volume by applying the formula of the truncated cone volume (volume = TD × LD × depth × 1/3). They reported that 55.5% of cases were smaller than 4 cm3, and 13.9% were larger than 9 cm3. Our results tended to be larger than the findings of Chiarini et al and Somé et al. Differences in the measurement and calculation methods may explain the differences between our results and those of previous reports. It may also be a factor that the herniated bowel stretches the ISF, increasing its size in this study.

Regarding the orifice location, Testut described that the left common iliac artery is situated dorsal to the orifice [13]. Whereas in all our cases, the orifice was located inferior to the bifurcation of the common iliac artery. Our cases may have a lower orifice position, and the lower position of the orifice may correlate to the risk of ISH.

Our study had several limitations. Although reconstructed images in two or more directions were obtained in all cases, the image acquisition protocol was inconsistent. This variety may not be a significant problem in assessing anatomical evaluation but may cause some bias. Although there are some cases that require resection of the small bowel due to ischemia [6], all our cases were treated by the reduction of the incarcerated hernia. This bias may be due to the small sample size. Further investigations with a larger sample size are required.

# Declarations


### Funding

The authors have no relevant financial or non-financial interests to disclose.


### Conflicts of interest/Competing interests

The authors declare that they have no competing interests.

### Ethics approval

The Institutional Research Review Board in each institution reviewed and approved this article.

### Consent to participate and to publish

We applied Opt-out method to obtain consent to participate and to publish on this study by using the poster in each institutions. The poster were approved by the Institutional Review Board in each institutions.

### Availability of data and material

The datasets analyzed are available from the corresponding author on reasonable request.

### Code availability

We used 3D-slicer, a free and open-source software application for visualization and analysis of medical image computing data sets and to create volume rendering images from CT images.

### Authors' contributions

Y Tashiro: Project development, Data management, Data analysis, Manuscript writing

N Takeyama: Project development, Data management, Data analysis

K Kachi Manuscript editing

Y Hori: Manuscript editing

K Kijima: Data Collection, Manuscript editing

T Umemoto: Data Collection, Manuscript editing

K Tanaka: Data Collection, Manuscript editing

K Ryu: Data Collection, Manuscript editing

S Satoh: Data Collection, Manuscript editing

T Hashimoto: Data Management, Manuscript editing

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**Competing intersets**

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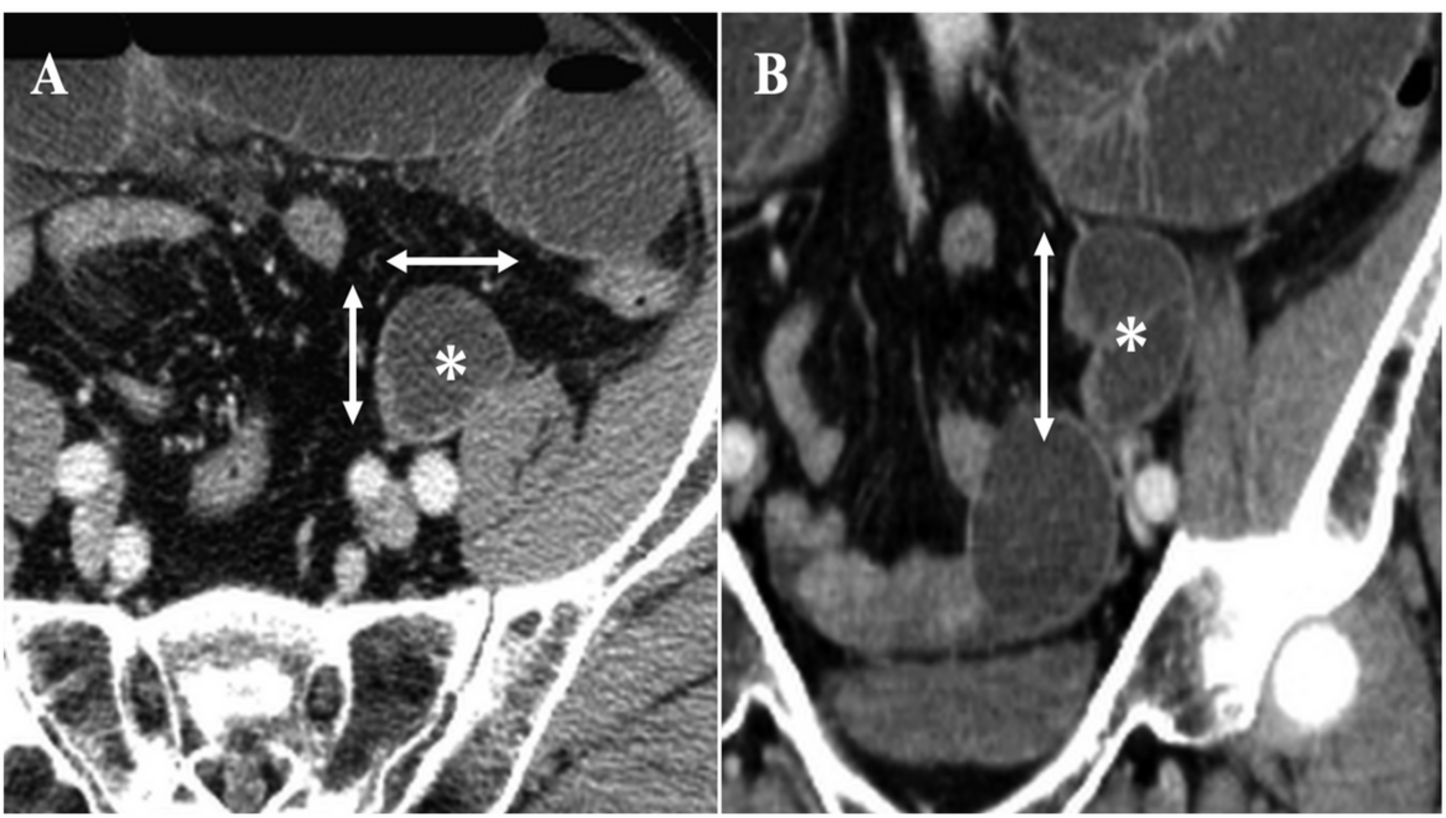
# Table

Table 1 is available in the Supplementary Files section.

# Figures

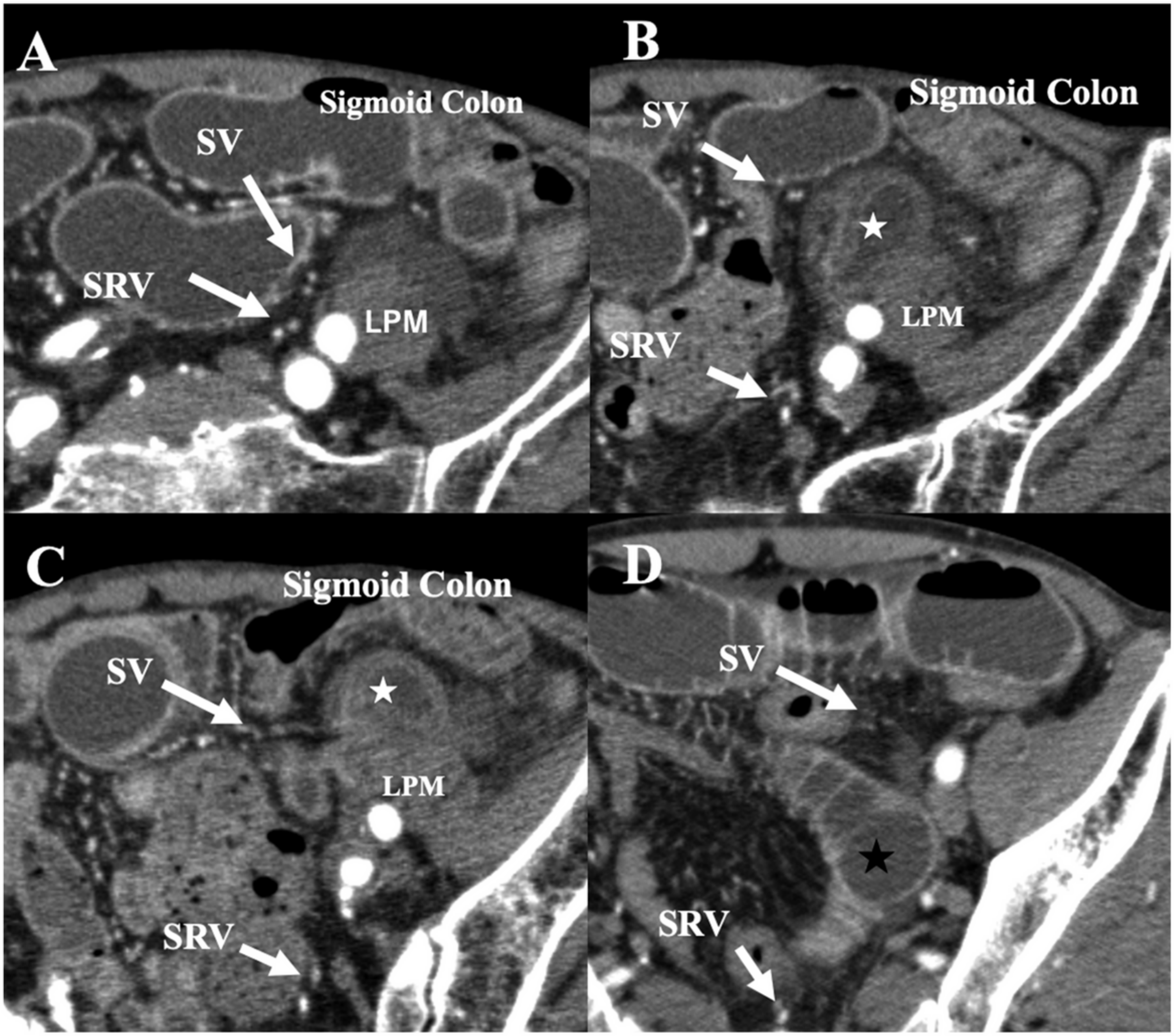


## Figure 1

A 61-year-old man with intersigmoid hernia. A Axial and B Coronal contrast-enhanced CT images show the small bowel loop in the left side of the pelvic space (asterisk). We measured the size of the loop in the lateral and anterior-posterior length at the axial plane and the caudal-cranial length at the coronal plane in each largest section (two-headed arrow).

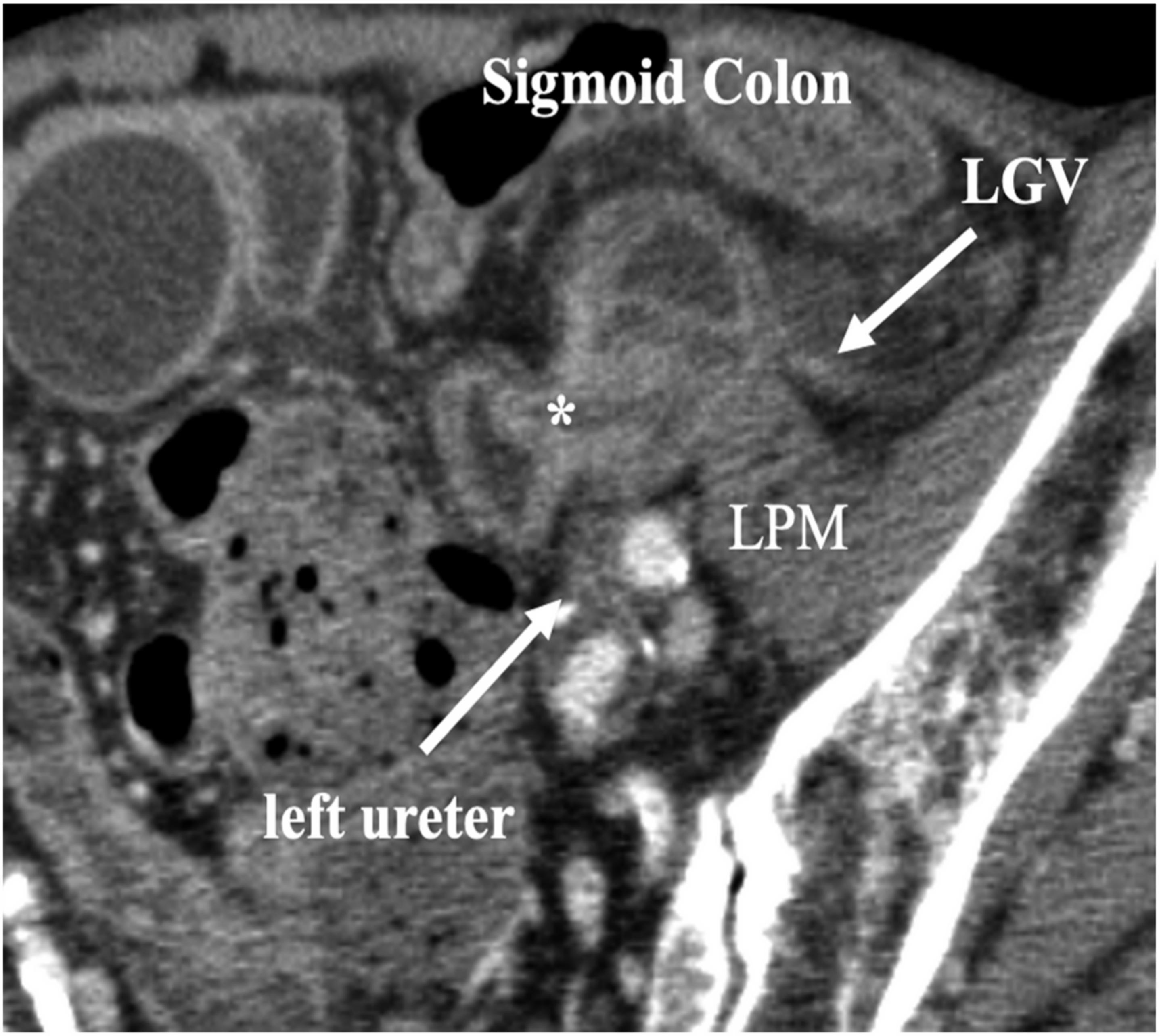

## Figure 2

A 68-year-old with intersigmoid hernia. Coronal contrast-enhanced CT image shows the strangulated small bowel (arrow). The vertical distance between the bowel occlusion point and bifurcation of the left common iliac artery (asterisk) was measured (two-headed arrow)



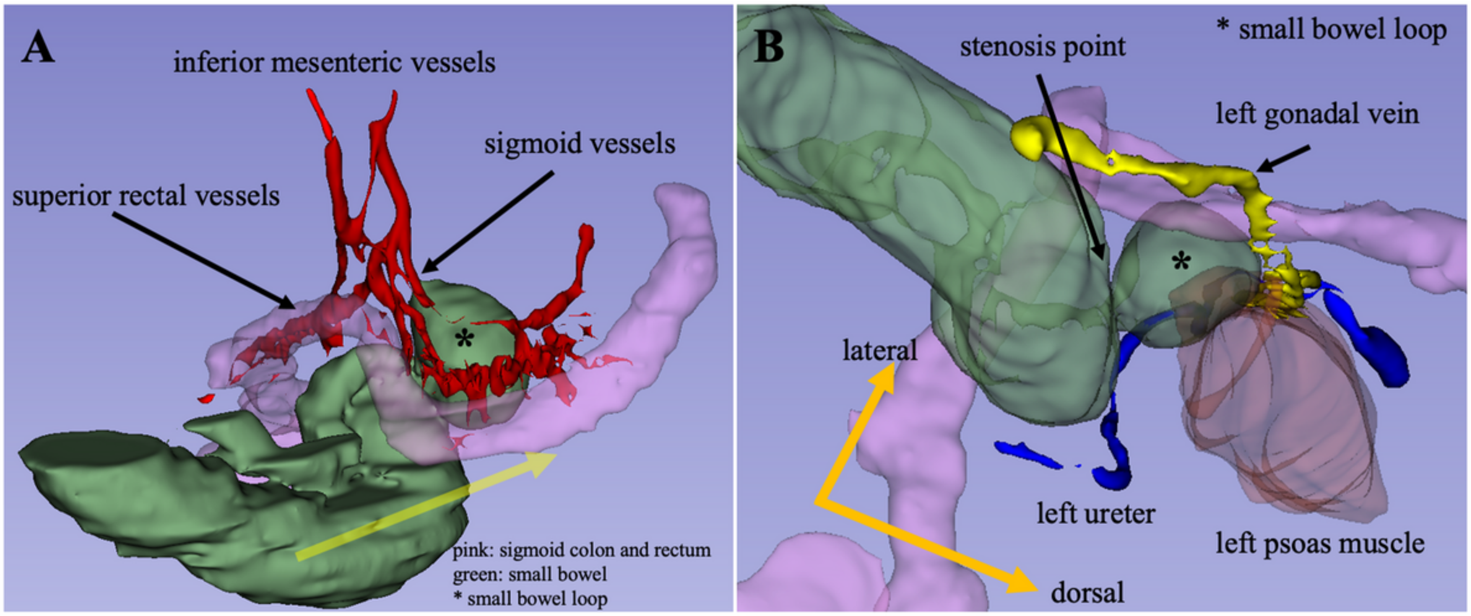

## Figure 3

An 85-year-old man with intersigmoid hernia. A-D Contrast-enhanced CT images in arterial phase from cranial to caudal section. B, C Small bowel loop (white star) lies between the sigmoid colon and the left psoas muscle (LPM). D The dilated bowel (black star) run under the point that the inferior mesenteric vessels bifurcated to the superior rectal vessels (SRV) and the sigmoid vessels (SV).




### Figure 4

An 85-year-old man with intersigmoid hernia (same case as Fig.3.). Contrast-enhanced CT image in delayed phase shows that the left ureter runs dorsal to the point of the bowel stenosis (asterisk), and the left gonadal vein (LGV) runs lateral to the small bowel loop.




### Figure 5

62-year-old man with intersigmoid hernia. Volume rendering (VR) images were created by segmenting each organ in the contrast-enhanced CT images using a 3D-slicer, which is a free and open-source software application for visualization and analysis of medical image computing data sets. A Right lateral view of the VR image shows the small bowel running under the point that the inferior mesenteric vessels bifurcated to the superior rectal vessels and the sigmoid vessels (yellow arrow). B Caudal and right lateral view of the VR image shows the left ureter running dorsally to the stenosis point. The left gonadal vein runs laterally at the small bowel loop (*).

## Supplementary Files

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- Table1.docx