

# Anterior uterine wall: normal and abnormal CT and MRI findings after cesarean section

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## ABSTRACT

Cesarean section is the most commonly performed surgical procedure in women. The surgical incision line in the uterus is generally located in the lower segment of the anterior uterine wall. Acquaintance with the normal and abnormal findings of the anterior uterine wall is of critical importance for imagers in this era of ever increasing cesarean sections performed worldwide.

Cesarean section (CS) is a very common surgical procedure in women. The procedure is well-known for a long time, dating back to ancient times. A cuneiform Babylonian tablet describes a procedure similar to cesarean birth in 1772 BC (1). The etymological origin of the word cesarean is the Latin verb “caedere”, which means “to cut” in modern English and was likely derived from the myth that the Roman emperor Julius Caesar was born by CS (1). Since CS is thought to be the most commonly performed abdominal surgery in women, complications related to it are not unlikely to be seen (2). Complications such as hematoma, infection, and fistula may occur after CS (3). Imaging methods are frequently used in the evaluation of complications in the days following CS (4). The aim of this article is to describe the expected normal and abnormal anterior uterine wall imaging, especially magnetic resonance imaging (MRI), findings after CS and show other potential complications of the CS such as fistula and cesarean scar defect.

## Surgical technique and normal postoperative imaging findings of cesarean delivery

Pfannenstiel transverse skin incision, which has been in use since the early 1900s, is a commonly utilized surgical approach made popular when first described by Monro Kerr in 1926 (3). Joel-Chen incision is a different surgical technique that was reported to cause less morbidity compared with Pfannenstiel approach (3). The main difference between these two techniques is the location of the skin incision (Fig. 1). The usual incision site in Pfannenstiel incision is 2 fingerbreadths above the pubic symphysis, while it is 3 cm below the line between the anterior-superior iliac spines in Joel-Cohen incision (3). After the skin incision, the underlying fascia is sharply opened and the rectus muscle is dissected and separated. After the peritoneum is reached the operator should be extremely meticulous while entering the peritoneum, in order not to damage any adjacent anatomic structures like urinary bladder and adjacent bowel segments. After this step, the uterus is well-exposed to the surgeon and an incision in the lower segment of the anterior uterine wall is created (this step is also called “hysterotomy”) (3). A transverse incision is preferred over a vertical incision as there is lower risk of uterine rupture in subsequent pregnancies, less blood loss, and a lower risk of bladder rupture. After this step the baby is delivered by applying pressure on the fundal segment of the uterus, which is followed by the delivery of the placenta (3). The uterine incision is then sealed with double-layer closure approach over single layer closure as the risk of uterine rupture is lower with the former (5). The surgery is finalized after closing the peritoneum, fascia, and the skin.

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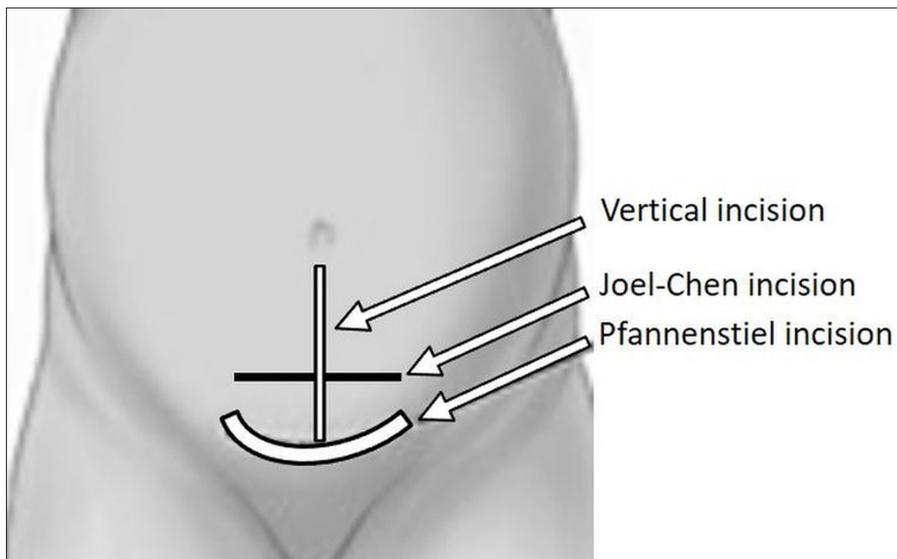
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## Normal imaging appearance of the anterior uterine wall

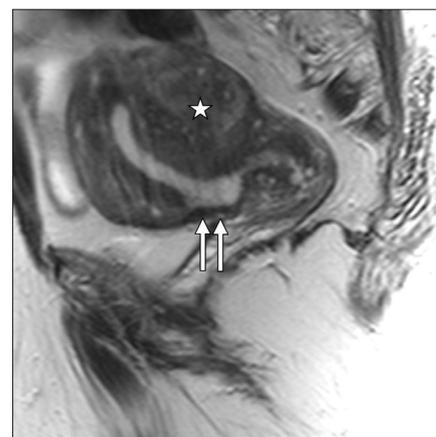
A variety of imaging modalities can be used in the evaluation of normal and abnormal post-CS findings (4). Ultrasonography (US) is the most preferred first-line imaging method (4). US may be useful in showing pelvic effusion and hematoma, but may be inadequate to assess the extent of abnormalities. The most preferred imaging method to show the abnormal post-CS findings is computed tomography (CT) (6, 7). The most important advantage of CT is that it allows for rapid evaluation of the entire pelvic region. CT can also be used to rule out vascular abnormalities such as active arterial bleeding and thrombosis. Intravenous contrast material should be administered to distinguish normal and abnormal findings on CT images. Recently, MRI has increasingly been used to show post-cesarean complications (4, 8). The most important advantage of MRI is that it shows the localization and extent of abnormal postpartum abnormalities better than CT because of high tissue contrast (4). In the early phase after CS, the incision site of the hysterotomy may appear as an oval area extending from the uterine cavity to the outer edge of the anterior uterine wall. This incision site appears hypoechoic relative to the myometrium on US, shows as an oval hypodense area on CT, and has higher signal intensity relative to muscles in the myometrium of the anterior lower uterine segment on T1- and T2-weighted images (4, 8). Low signal intensity at the incision site on T2-weighted images, probably secondary to subacute hematoma, should not be confused with dehiscence. The low transverse incision site is best visualized in the sagittal plane reformat on CT or MRI and the vertical incision site is best visualized on axial CT or MRI (Figs. 2 and 3). Also, a small hematoma which appears hyperechoic on US and a high-attenuation collection on CT



**Figure 1.** A diagram showing the Joel-Cohen, Pfannenstiel, and vertical incisions. The main difference between these techniques is the location of the skin incision.



**Figure 2.** A 32-year-old woman with CS. Normal post-CS anterior uterine wall demonstrating long segment muscular loss and thinning (arrows) in the lower segment of the anterior uterine wall on T2-weighted sagittal image.



**Figure 3.** A 28-year-old woman with CS. Normal post-CS anterior uterine wall demonstrating shorter segment muscular loss and thinning (arrows) in the lower segment of the anterior uterine wall on T2-weighted sagittal image. Also, note the presence of adenomyosis in the myometrium (asterisk).

may be seen at the uterine incision site or the prevesical space (4, 8). The MRI findings of hematoma can change over time, but it usually shows high signal intensity on T1- and T2-weighted images in the subacute phase. At chronic stages, the incision line appears less conspicuous but muscular defect at the hysterotomy site can be prominent in some cases. The incision area shows low-to intermediate signal intensity on T1- and T2-weighted images (4). Findings described above can also be seen in case of acute complications after CS. Therefore, all image findings should always be interpreted along with the clinical findings of the patient.

## Abnormal findings after cesarean delivery

### Vesicouterine fistula

Vesicouterine fistulas are rarely seen in daily clinical practice and this clinical condition is almost always related to CS (9). The incidence of vesicouterine fistula increases with the number of CSs, therefore, clinical suspicion should be higher in patients with a history of repeat CSs. From an anatomical standpoint, the bladder and the lower segment of the anterior uterine wall are closely related and this anatomic relationship renders the bladder more susceptible

### Main points

- Acquaintance with the normal and abnormal imaging findings after cesarean section is of highest clinical importance for the imaging specialists.
- MRI is a valuable diagnostic tool and has been applied as a problem-solving modality for suspected post cesarean section abnormalities.
- Detection of an anterior myometrial wall defect and continuation of the endometrial contents into an isthmocele pouch are the most helpful imaging clues of cesarean scar defect.

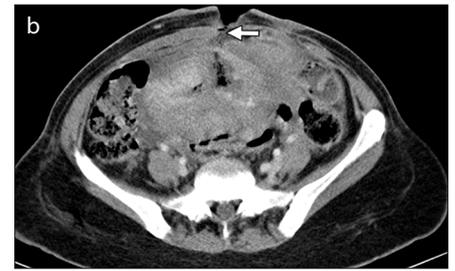
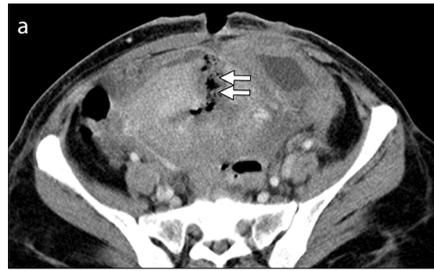


**Figure 4.** A 34-year-old woman complaining of urine draining from the vagina which started immediately after CS. Sagittal T2-weighted image of the uterus shows direct communication (*arrow*) between the lower segment of the anterior uterine wall and the bladder.

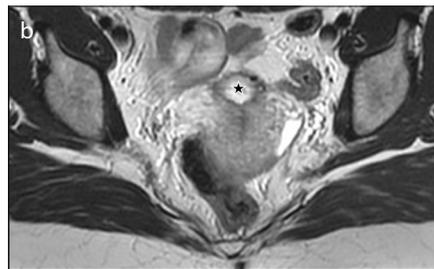
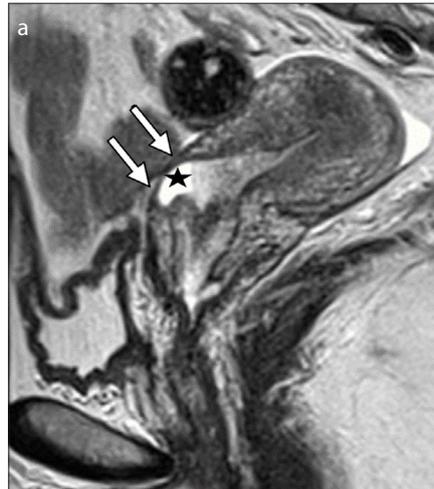
to surgical injuries (9). Intermittent hematuria, urine leakage, and incontinence are the most commonly reported clinical complaints. These fistulas are located at the level of isthmus or cervix, and the tract is lined by granulation tissue, inflammatory cells, and fibrous tissue (9). Vesicouterine fistulas may heal spontaneously, albeit, this is a rare occurrence. Surgical treatment is generally indicated. Cystoscopy, hysterosalpingography, and cystography are common conventional diagnostic modalities with imaging playing an ever-increasing role in the diagnosis. Transvaginal US may directly detect the fistula in some cases (10). CT may also be helpful to outline the abnormal tract. MRI, with its excellent soft tissue resolution, is very helpful for the diagnosis, making it the imaging modality of choice. T2-weighted images are the most commonly utilized sequences and may allow direct visualization of the abnormal communication (11) (Fig. 4).

#### Uterocutaneous fistula

Uterocutaneous fistulas are rare and generally occur after CS, but uterine trauma during curettage and radiotherapy should also be counted among the causes (12). Bloody or purulent discharge from the fistula is a common clinical finding. The diagnosis is conventionally made by fistulography with injection of contrast through the cutaneous end of the fistula (12). In addition to



**Figure 5. a, b.** A 29-year-old woman with purulent drainage through the CS scar starting 3 days after the surgery. Axial contrast-enhanced CT image (a) shows the fistulous tract extending from the endometrial cavity to the skin (*arrows*). CT image from a lower level (b) shows the opening of the fistula to the skin (*arrow*).

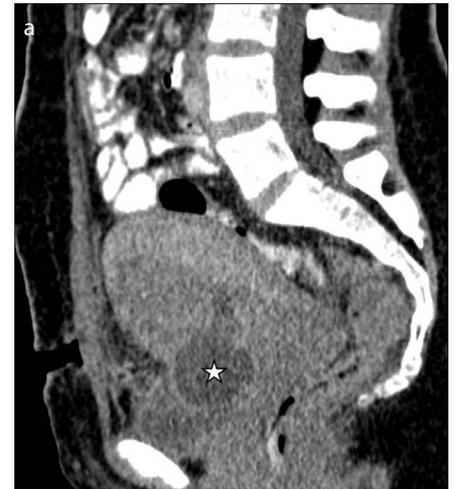


**Figure 6. a, b.** A 34-year-old woman with continuous abnormal uterine bleeding and pelvic pain 3 months after CS. Axial plane T2-weighted image (a) shows herniating endometrial content (*asterisk*) through the anterior uterine wall defect. Sagittal plane T2-weighted image (b) of the same patient better outlines the anterior uterine wall defect (*arrows*) and the externally herniated endometrium (*asterisk*).

conventional diagnostic methods, with the advent of cross-sectional imaging modalities the diagnosis can also be safely made with CT or MRI (Fig. 5).

#### Cesarean scar defect

There is no universally accepted definition of cesarean scar defect (CSD). The detection of focal thinning of the myometrium or a triangular defect in the myometrium that is continuous with the endo-



**Figure 7. a, b.** A 28-year-old woman with severe pelvic pain and copious bleeding per vagina 2 days after the cesarean section. Sagittal reconstructed contrast-enhanced CT image (a) shows an abnormal cystic structure (*asterisk*) anterior to the uterus. Sagittal T2-weighted image (b) of the same patient shows that the cystic structure depicted in the CT image represents a large isthmocele (*asterisk*).

metrium are the most commonly referred definitions in the literature (13). This focal pouch formation may sometimes also be named as isthmocele. The term “isthmocele” is a relatively new medical term which was first described in 1995 and the first report of laparoscopic repair of it was published in 2003 (14). Given the explosive pace of increasing CS surgeries in the world, it would not be completely unexpected to see more cases soon. However, there is a

relative paucity of scientific data regarding the diagnosis and treatment of CSD. Repeat CS, uterine position, labor before CS, and surgical technique have all been mentioned as risk factors for CSD occurrence. Uterine morphology has also been implicated as a risk factor, with retroverted uterus reported to be more prone to CSD occurrence (13, 15) (Fig. 6). The most commonly associated symptoms with CSD are abnormal uterine bleeding, secondary infertility, ectopic scar pregnancy, and pain (13). Early detection and treatment is of critical importance to prevent these potential complications. Transvaginal US is generally the first imaging modality to be used; however, MRI may better evaluate the complete extent of this clinical problem. T2-weighted sequences are the most commonly utilized images as internal genitalia can be evaluated in detail (Fig. 7). Detection of an anterior myometrial wall defect and continuation of the endometrial contents into the isthmocele pouch are the most helpful imaging clues.

## Conclusion

Acquaintance with normal and abnormal imaging findings after CS is of highest clinical importance for the imaging specialist, since it would not be surprising to see more abnormalities involving the anterior uterine

wall in daily radiology practice, with the ever increasing global rates of CS. MRI is a valuable diagnostic tool and has been used as a problem-solving modality for suspected post-CS abnormalities.

### Conflict of interest disclosure

The authors declared no conflicts of interest.

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