Differentiation of a Femoral Hernia from an Inguinal Hernia on Isotropic Multidetector-Row CT (MDCT): the Benefit of Inguinal Ligament Coronal-Oblique Images[1]

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Purpose: This study was designed to evaluate the diagnostic value of the use of inguinal ligament coronal-oblique CT images in the differentiation of femoral hernias from inguinal hernias.

Materials and Methods: A total of 32 patients (with 11 femoral hernias and 21 inguinal hernias) underwent CT imaging. All of the examinations were performed with a 16-multidetector row CT (MDCT) scanner with contrast enhancement, and transverse sections, coronal sections and coronal-oblique CT images were reformed along an imaginary inguinal ligament plane. Two independent observers retrospectively evaluated the CT scans. Image analysis was first performed with only transverse and coronal images. A second analysis was then performed with transverse, coronal and coronal-oblique images.

Results: The mean angle difference between coronal and coronal-oblique CT images was 8.0 degrees (range, 0–22 degrees). A radiologist correctly diagnosed the presence of a femoral hernia in nine (82%) of 11 patients and a radiology fellow correctly diagnosed the presence of a femoral hernia in seven (64%) of 11 patients in the first session. Both of the reviewers made the correct diagnosis in all patients in the second session. For inguinal hernias, both reviewers correctly diagnosed all patients during both sessions. The coronal-oblique CT images were the most valuable images for the evaluation of the relationship between hernias of the neck and inguinal ligament.

Conclusion: Inguinal ligament coronal-oblique CT images can provide additional diagnostic value in the evaluation of groin hernias.

Index words : Hernia, inguinal
Hernia, femoral
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Herniations of abdominal or pelvic contents in the groin are divided into two main categories: inguinal and femoral hernias. For the diagnosis of groin hernias, a physical examination plays a major role in the differentiation of inguinal hernias from femoral hernias (1). Surgeons differentiate femoral hernias from inguinal hernias by ascertaining the relationship between the neck of the sac to the medial end of the inguinal ligament and the pubic tubercle (2). However, it is sometimes difficult for surgeons to distinguish femoral hernias from inguinal hernias using a physical examination alone (3). The neck of a femoral hernia is located below and lateral to the medial end of the inguinal ligament (4), whereas the neck of an inguinal hernia is located above and medial to the inguinal ligament (2). Inguinal hernias are subdivided into indirect inguinal hernias and direct inguinal hernias. An indirect inguinal hernia originates at the deep inguinal ring, lateral to the inferior epigastric artery. A direct inguinal hernia passes medially to the inferior epigastric artery through a defect in the Hesselbach triangle. Thus, the inguinal ligament and inferior epigastric artery are important structures in the evaluation of groin hernias. The inguinal ligament runs from the anterior superior iliac spine of the ilium to the pubic tubercle of the pubic bone. The inferior epigastric artery arises from the external iliac artery. In addition, along its course, the inferior epigastric artery is accompanied by a similarly named vein, the inferior epigastric vein. With the advent of the use of multidetector-row computed tomography (MDCT), the inguinal ligament and inferior epigastric vessels can be consistently visualized on contrast-enhanced CT images with coronal and sagittal reformations, which permit the accurate diagnosis of groin hernias (4, 5).

To the best of our knowledge, there has been no study that has focused on the evaluation of groin hernias using coronal-oblique reformed CT images along an imaginary inguinal ligament plane from the pubic tubercle to the anterior superior iliac spine (henceforth referred to as "coronal-oblique CT images of the inguinal ligament"). The purpose of this study was to assess the benefit of the use of inguinal ligament coronal-oblique CT images for the diagnosis of groin hernias.

Materials and Methods

Patients and Imaging

This study was approved by our institutional review board, which waived the requirement of patient informed consent. Between January 2005 and December 2007, 32 patients with groin hernias underwent diagnostic CT examinations less than one month prior to treatment. The mean age of the patients was 54.3 years (age range, 17–85 years; median age, 69.5 years). The patients consisted of 15 females and 17 males with a total of 11 femoral hernias and 21 inguinal hernias.

All examinations were performed with the use of a 16-detector MDCT scanner (MX IDT 8000; Philips Medical Systems, Best, The Netherlands) using a collimation of 16×1.5 mm, an increment of 1.0 mm and a pitch of 1.2. All patients received 120 mL of IV iohexol (Omnipaque 300; Nycomed Amersham, Amersham, UK) that was administered with the use of a mechanical injector (Medrad; Warrendale, PA U.S.A.) at 3.0 ml/sec with a scanning delay of 70 sec. From the raw data of each acquisition, 5-mm-thick transverse sections and 4-mm-thick coronal sections were routinely reformed from the diaphragmatic dome to the anal verge. After a review of the transverse and coronal CT images, we acquired coronal-oblique CT images along an imaginary inguinal ligament plane with a 3-mm-thick cross section of the hernias. The angle difference between the coronal and coronal-oblique CT images of the inguinal ligament was recorded.

CT Analysis

Two independent reviewers (an abdominal faculty radiologist with six years of experience and a radiology fellow with nine months of experience) retrospectively evaluated the CT images. Both reviewers were unaware of the surgical findings and each reviewer analyzed the images during two separate sessions. During the first session, only transverse and coronal CT images were evaluated. The second review session was performed three weeks after the first session. At this time, reviewers evaluated transverse, coronal and coronal-oblique CT images of the inguinal ligament. To ensure the objectivity and reproducibility of the image analysis performed in the study, criteria for femoral hernias and inguinal hernias was established. A hernia was diagnosed as a femoral hernia when the neck of the hernia sac was below the inguinal ligament. A hernia was diagnosed as an inguinal hernia when the neck was above the inguinal ligament. An indirect inguinal hernia was defined as a hernia that originated at the deep inguinal ring and was lateral to the inferior epigastric vessels, while a direct inguinal hernia was defined as a hernia that passed medially to the inferior epigastric vessels through a defect in the Hesselbach triangle. In each interpretation session, groin hernias as determined from CT images were classified into one of the following eight categories: definite femoral hernias, probable femoral hernias, indeterminate groin hernias, probable indirect inguinal hernias, definite indirect inguinal hernias, indeterminate inguinal hernias, probable direct inguinal hernias and definite direct inguinal hernias. The different CT findings of the reviewers from the two sessions were statistically tested with the use of Wilcoxon's signed rank test.

In the second session, each of the reviewers also noted

Table 1. Radiological Data for Patients with Femoral Hernias

Patient No.	Angle Difference[a]	Radiologist Diagnosis[b]	Radiologist Diagnosis[c]	Fellow Diagnosis[b]	Fellow Diagnosis[c]	Radiologist Neck/IL[d]	Fellow Neck/IL[d]
1	0	Definitely F	Definitely F	Definitely F	Definitely F	Col = Co	Col = Co
2	7	Definitely F	Definitely F	Definitely F	Definitely F	Col = Co	Col = Co
3	8	Definitely F	Definitely F	Probably F	Definitely F	Col = Co	Col = Co
4	8	Probably F	Definitely F	Probably F	Definitely F	Col = Co	Col
5	9	Definitely F	Definitely F	Probably F	Definitely F	Col	Col
6	10	Definitely F	Definitely F	Probably F	Definitely F	Col	Col
7	15	Probably F	Definitely F	Indeterminate G	Definitely F	Col	Col
8	16	Probably F	Definitely F	Probably F	Definitely F	Col	Col
9	20	Indeterminate G	Definitely F	Probably IH	Definitely F	Col	Col
10	21	Probably F	Definitely F	Probably IH	Definitely F	Col	Col
11	22	Indeterminate G	Definitely F	Probably IH	Definitely F	Col	Col

IL = inguinal ligament; F = femoral hernias; G = groin hernias; IH = indirect inguinal hernias; Col = coronal-oblique CT images of inguinal ligament; Co = Coronal CT images

[a]Angle difference between coronal-oblique CT images of the inguinal ligament and coronal CT images.

[b]Diagnosis after evaluation of transverse and coronal CT images.

[c]Diagnosis after evaluation of transverse, coronal, and coronal-oblique CT images of the inguinal ligament.

[d]Most useful CT images for the assessment of the relationship between the neck of the hernia and the inguinal ligament.

Table 2. Radiological Data for Patients with Inguinal Hernias

Patient No.	Angle Difference[a]	Radiologist Diagnosis[b]	Radiologist Diagnosis[c]	Fellow Diagnosis[b]	Fellow Diagnosis[c]	Radiologist Neck/IL[d]	Fellow Neck/IL[d]
1	0	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
2	0	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
3	0	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
4	0	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
5	0	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
6	1	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col = Co	Col
7	2	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col
8	3	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col = Co	Col = Co
9	4	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col = Co
10	4	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col	Col
11	5	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col = Co	Col
12	6	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col	Col
13	6	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col = Co	Col
14	7	Probable IH	Definitely IH	Probable IH	Definitely IH	Col	Col
15	8	Definitely IH	Definitely IH	Definitely IH	Definitely IH	Col	Col
16	8	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col	Col
17	8	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col	Col
18	10	Probably IH	Definitely IH	Probable IH	Definitely IH	Col	Col
19	10	Definitely IH	Definitely IH	Probable IH	Definitely IH	Col	Col
20	11	Probable IH	Definitely IH	Probable IH	Definitely IH	Col	Col
21	15	Probable IH	Definitely IH	Probable IH	Definitely IH	Col	Col

IL = inguinal ligament; IH = indirect inguinal hernias; Col = coronal-oblique CT images of inguinal ligament; Co = Coronal CT images

[a]Angle difference between coronal-oblique CT images of the inguinal ligament and coronal CT images.

[b]Diagnosis after evaluation of transverse and coronal CT images.

[c]Diagnosis after evaluation of transverse, coronal, and coronal-oblique CT images of the inguinal ligament.

[d]Most useful CT images for the assessment of the relationship between the neck of the hernia and inguinal ligament.

images that were considered as the most useful reformed CT images in terms of views of the inguinal ligament and inferior epigastric vessels. The reviewers also recorded the content of the hernia sac as depicted on CT images.

Results

The radiological data of our study is summarized in Tables 1 and 2. The mean angle difference between coronal and coronal-oblique CT images of the inguinal ligament was 8.0 degrees (range, 0–22 degrees; median, 7.5 degrees). In six (19%) of the patients, depictions on coronal-oblique CT images of the inguinal ligament were the same as routine coronal CT images. For 21 inguinal hernias, there was no direct hernia.

Of the 11 femoral hernias, there were six incarcerated small bowel herniations, four omental fat herniations and one bladder herniation. Of the 21 inguinal hernias, there was one strangulated small bowel herniation, four incarcerated small bowel herniations and 16 omental fat herniations.

The faculty radiologist correctly diagnosed nine (82%) of the 11 femoral hernias in the first session and correctly diagnosed all of the patients in the second session. The radiology fellow correctly diagnosed seven (64%) of the 11 femoral hernias in the first session and correctly diagnosed all of the patients in the second session. The radiology fellow misdiagnosed four femoral hernias in five patients who had an angle difference between the coronal-oblique CT images of the inguinal ligament and coronal CT images equal to or more than 15 degrees. The faculty radiologist misdiagnosed two femoral hernias in three patients who had an angle difference between the coronal-oblique CT images of the inguinal ligament and coronal CT images equal to or more than 20 degrees in the first session (Fig. 1). The coronal-oblique CT images of the inguinal ligament were found as the most useful images for the evaluation of the relationship between the neck of the hernia and the inguinal liga-

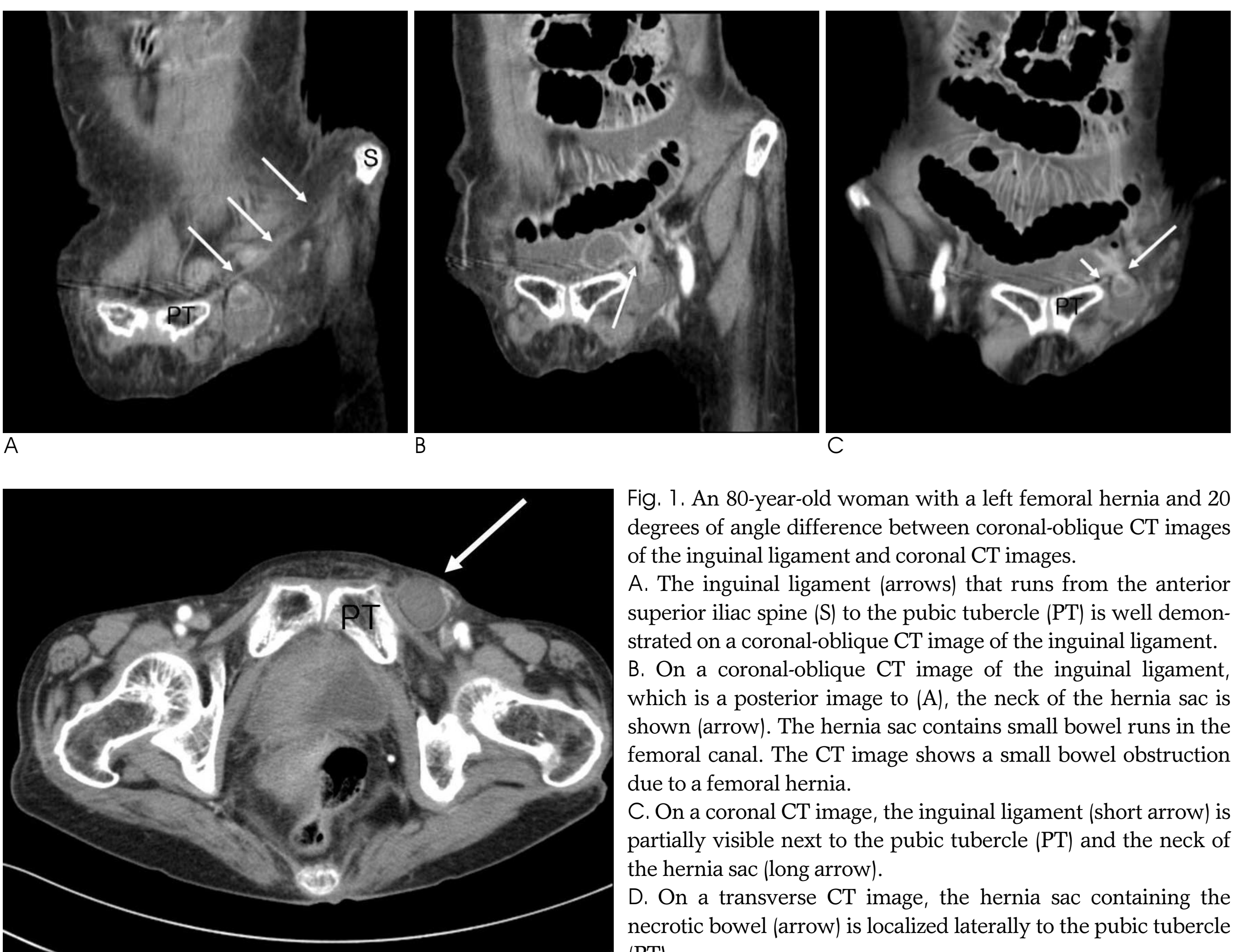

Fig. 1. An 80-year-old woman with a left femoral hernia and 20 degrees of angle difference between coronal-oblique CT images of the inguinal ligament and coronal CT images.
A. The inguinal ligament (arrows) that runs from the anterior superior iliac spine (S) to the pubic tubercle (PT) is well demonstrated on a coronal-oblique CT image of the inguinal ligament.
B. On a coronal-oblique CT image of the inguinal ligament, which is a posterior image to (A), the neck of the hernia sac is shown (arrow). The hernia sac contains small bowel runs in the femoral canal. The CT image shows a small bowel obstruction due to a femoral hernia.
C. On a coronal CT image, the inguinal ligament (short arrow) is partially visible next to the pubic tubercle (PT) and the neck of the hernia sac (long arrow).
D. On a transverse CT image, the hernia sac containing the necrotic bowel (arrow) is localized laterally to the pubic tubercle (PT).

ment in patients with a femoral hernia.

For the 21 inguinal hernias, both the faculty radiologist and the radiology fellow correctly diagnosed all of the hernias in the two sessions. In the second session, of the 21 indirect inguinal hernias, the faculty radiologist and the radiology fellow changed their classification of four (19%) and 11 hernias (52%), respectively, from probable indirect inguinal hernias to definite indirect inguinal hernias (Fig. 2). The coronal-oblique CT images of the inguinal ligament and the coronal CT images were considered as the most useful for the evaluation of the relationship between the neck of the hernia and the inguinal ligament in patients with inguinal hernias. For the evaluation of the relationship between the hernia sac and the inferior epigastric vessels, both the coronal-oblique CT images of the inguinal ligament and the coronal CT images were found as the most useful images for all 32 groin hernias.

The differences in the CT findings for the two sessions showed that evaluation with transverse, coronal, and coronal-oblique CT images of the inguinal ligament resulted in significantly more accurate diagnostic results than evaluation with only transverse and coronal CT images for both the faculty radiologist and radiology fellow ($p < 0.05$).

Discussion

Groin hernias are divided into two main categories: inguinal and femoral hernias. Approximately 95% of groin hernias are inguinal hernias (6). In a previous randomized clinical trial, watchful waiting for men with asymptomatic or minimally symptomatic inguinal hernias was suggested as an acceptable option (7). However, about 40% of femoral hernias present with incarceration or strangulation because of the narrowness of the femoral ring (2). Thus, urgent surgery for femoral hernias is recommended even in an asymptomatic patient. Because of the tendency for a hernia to move upward to a position above the inguinal ligament, a femoral hernia may sometimes be mistaken for an inguinal hernia by a surgeon (3, 8). This situation was observed for all femoral hernias of our study. Therefore, distinguishing tests are needed to differentiate femoral hernias from inguinal

A B C

D

Fig. 2. A 77-year-old man with a right inguinal hernia and 10 degrees of angle difference between the coronal-oblique CT images of the inguinal ligament and the coronal CT images.
A. The inguinal ligament (arrows) that runs from the anterior superior iliac spine (S) to the pubic tubercle (PT) is well demonstrated on a coronal-oblique CT image of the inguinal ligament.
B. On a coronal-oblique CT image of the inguinal ligament, which is the anterior image to (A), the neck of the hernia sac is shown (arrow). The hernia sac goes out from the inguinal canal.
C. On a coronal CT image, the inguinal ligament (short arrows), femoral artery (arrowhead) and the neck of the hernia sac (long arrow) are closely demonstrated.
D. On a transverse CT image, the hernia sac (arrow) extends medially to the pubic tubercle (PT).

hernias. The useful role of CT in the evaluation of groin hernias has been previously reported (5, 9). In particular, MDCT can produce images of the inguinofemoral region in detail (4). The important structures of the inguinofemoral region are the inguinal ligament, the inferior epigastric artery, the round ligament or spermatic cord, the internal ring and the femoral spaces with its contents. The detection of all important structures of the inguinofemoral region in patients with groin hernias is difficult due to the mass effect of the hernia sac. Moreover, the detection of all important structures of the inguinofemoral region is not required in the diagnosis of groin hernias. In the differentiation of femoral hernias from inguinal hernias, the inguinal ligament is the most crucial anatomic structure. In the differentiation of a direct inguinal hernia from an indirect inguinal hernia, the inferior epigastric artery is a key structure. Thus, clarification of the relationships between the neck of the hernia sac and the inguinal ligament and between the hernia sac and the inferior epigastric artery are very important.

The inguinal ligament was not depicted on transverse CT images (2, 3) but the inguinal ligament was well visualized on coronal or sagittal MDCT images (91–95%) (4, 5). However, this ligament was not defined on these images in all patients (4, 5). The inguinal ligament joins the anterior superior iliac spine to the pubic tubercle. Therefore, we thought that coronal-oblique reformed CT images along an imaginary inguinal ligament plane (from the pubic tubercle to the anterior superior iliac spine) with the use of MDCT might be helpful for diagnosis of groin hernias.

In this study, the skilled faculty radiologist and a less experienced radiology fellow were both able to establish the correct diagnosis of indirect inguinal hernias in two separate sessions. However, the reviewers provided the correct diagnosis of the femoral hernias in only the second session. In our study, all indirect inguinal hernias had a hernia sac that extended from the internal inguinal ring to the scrotum or labium, and both reviewers were able to diagnose correctly the hernia by tracing the hernia sac thoroughly from the internal inguinal ring to the scrotum or labium. For femoral hernias, the radiology fellow misdiagnosed four femoral hernias in five patients where the angle difference between coronal-oblique CT images of the inguinal ligament and coronal CT images was equal to or more than 15 degrees in the first session. The faculty radiologist misdiagnosed two femoral hernias in three patients where the angle difference between coronal-oblique CT images of inguinal ligament and coronal CT images was equal to or more than 20 degrees in the first session. A more closely demonstrated inguinal ligament, pubic tubercle and neck of the femoral hernia as depicted on coronal CT images with an increment of angle difference might have caused the reviewers to misdiagnose a femoral hernia as an indirect inguinal hernia in the first session (Fig. 1). This difficulty in the differentiation of a femoral hernia from an inguinal hernia due to a closely demonstrated inguinal ligament, pubic tubercle and neck of the hernia was eased and the correct diagnosis of groin hernias improved after the acquisition of coronal-oblique CT images of the inguinal ligament.

This study has a number of limitations. First, when evaluating groin hernias on CT images, we did not include sagittal CT images. We routinely acquired transverse and coronal CT images in the evaluation of the abdomen and pelvis. Thus, it would be beneficial to make additional reformations to acquire sagittal or coronal-oblique CT images of the inguinal ligament. The reviewers in this study found that coronal-oblique CT images of the inguinal ligament were more helpful than sagittal images in the demonstration of the inguinal ligament on CT imaging. Second, direct inguinal hernias were not included in our study. The diagnosis of an inguinal hernia usually rests on the history provided by the patient and an examination of the groin by a physician. Further tests are rarely needed to confirm the diagnosis. However, in unclear cases, an ultrasound scan or a CT scan has been performed in our institution, especially to rule out the presence of a hydrocele. In direct hernias, the hernia sac passes medially to the inferior epigastric vessels through a defect in the Hesselbach triangle and is rarely confused with a scrotal lesion. For this reason, the clinician did not perform CT imaging for the diagnosis of direct inguinal hernias. Third, we could not ascertain what determined the angle difference between coronal-oblique CT images of the inguinal ligament and routine coronal CT images. Fourth, we did not statistically assess the most useful reformed CT images with views of the neck location concerning the inguinal ligament and inferior epigastric vessels. Fifth, the extent of the hernia sac based on the relationship between the hernia sac and pubic tubercle, and the compression of the femoral vein on transverse CT images are useful findings for the diagnosis of femoral hernia (9). However, we did not evaluate the extent of the hernia sac based on the relationship between the hernia sac and the pubic tubercle, nor did we assess the presence of femoral vein compression as seen on transverse CT images.

In summary, the preoperative differentiation of femoral hernias from inguinal hernias is clinically relevant. The location of the neck of the hernia in relation to the inguinal ligament is the first step to differentiate femoral hernias from inguinal hernias. Using additional coronal-oblique CT images of the inguinal ligament, we were able to evaluate exactly the location of the neck of the hernia in relation to the inguinal ligament, which led to the correct diagnosis of groin hernias.

In conclusion, inguinal ligament coronal-oblique CT images can provide additional diagnostic value in the evaluation of groin hernias.

References

1. van den Berg JC, de Valois JC, Go PM, Rosenbusch G. Radiological anatomy of the groin region. *Eur Radiol* 2000;10:661-670
2. Kingsnorth A, Bennet DH. *Hernias, umbilicus, abdominal wall.* In: Russel RCG, Williams NS, Bulstrode CJK, eds. *Bailey & Love's short practice of surgery.* London: Edword Arnold, 2000:1143-1162
3. Naude GP, Ocon S, Bongard F. Femoral hernia: the dire consequences of a missed diagnosis. *Am J Emerg Med* 1997;15:680-682
4. Cherian PT, Parnell AP. The radiological anatomy of the inguinofemoral region: new insights from multi-slice spiral computerized tomography. *AJR Am J Roentgenol* 2007;189:W177-183
5. Cherian PT, Parnell AP. The diagnosis and classification of inguinal and femoral hernia on multisection spiral CT. *Clin Radio* 2008;63:184-192
6. Richards AT, Quinn TH, Fitzgibbons RJ Jr. *Abdominal wall hernias.* In: Greenfield LJ. *Surgery: Scientific Principles and Practice.* Philadelphia: Lippincott Williams & Wilkins, 2001:1185-1223
7. Fitzgibbons RJ Jr, Giobbie-Hurder A, Gibbs JO, Dunlop DD, Reda DJ, McCarthy M Jr, et al. Watchful waiting vs repair of inguinal hernia in minimally symptomatic men: a randomized clinical trial. *JAMA* 2006;295:285-292
8. Ponka JL, Brush BE. Problem of femoral hernia. *Arch Surg* 1971; 102:417-423
9. Suzuki S, Furui S, Okinaga K, Sakamoto T, Murata J, Furukawa A, et al. Differentiation of femoral versus inguinal hernia: CT findings. *AJR Am J Roentgenol* 2007;189:W78-83

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등방성 다검출 전산화단층촬영을 이용한 넙다리탈장과 샅굴탈장의 감별: 샅고랑인대 관상 - 사위영상의 부가적 진단 가치[1]

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목적: 넙다리탈장을 샅굴탈장과 감별하는데 샅고랑인대를 기준으로 재구성한 전산화단층촬영의 관상-사위영상의 진단적 가치를 알아보고자 하였다.

대상과 방법: 총 32명(넙다리탈장, 11예; 샅굴탈장, 21예)의 환자를 대상으로 전산화단층촬영을 시행하였다. 모든 검사에서 16채널 다검출 전산화단층촬영기로 조영제를 이용하여 횡단면, 관상면, 샅고랑인대의 관상-사위면 영상을 얻었다. 두 명의 영상의학과 의사가 독립적으로 영상을 분석하였다. 처음 단계에는 횡단면과 관상면을 이용하여 평가하였고, 두 번째 단계에서는 횡단면, 관상면, 관상-사위면을 함께 이용하여 평가하였다.

결과: 관상면과 관상-사위면의 평균각도 차이는 8.0도(범위, 0-22)였다. 영상의학 전문의와 전임의는 처음 단계에서 총 11예의 넙다리 탈장 중 각각 9예(82%), 7예(64%)의 넙다리 탈장을 진단하였다. 두 번째 단계에서는 두 명 모두 모든 예의 넙다리 탈장이 진단 가능하였다. 샅굴탈장은 두 명의 판독자 모두 처음과 두 번째 단계에서 각각 모든 예의 샅굴탈장이 진단 가능하였다. 샅고랑인대의 관상-사위면 영상은 넙다리탈장의 탈장목과 샅고랑인대의 관계를 평가하는 데 중요한 가치가 있었다.

결론: 샅고랑인대의 관상-사위영상은 샅고랑부위탈장의 평가에 부가적인 진단적 가치를 제공한다.