

## Cardiac CT for Calcium Scoring

*This procedure is reviewed by a physician with expertise in the area presented and is further reviewed by committees from the American College of Radiology (ACR) and the Radiological Society of North America (RSNA), comprising physicians with expertise in several radiologic areas.*

### What is Cardiac CT for Calcium Scoring?

CT scanning—sometimes called CAT scanning—is a noninvasive, painless medical test that helps physicians diagnose and treat medical conditions.

CT imaging uses special x-ray equipment to produce multiple images or pictures of the inside of the body and a computer to join them together in cross-sectional views of the area being studied. The images can then be examined on a computer monitor or printed.

CT scans of internal organs, bone, soft tissue and blood vessels provide greater clarity than conventional x-ray exams.

A cardiac CT scan is a non-invasive way of obtaining information about the location and extent of calcified plaque in the coronary arteries—the vessels that supply oxygen-containing blood to the heart wall. Plaque is a build-up of fat and other substances, including calcium, which can, over time, narrow the arteries or even close off blood flow to the heart. The result may be painful angina in the chest or a heart attack.

Because calcium is a marker of coronary artery disease, the amount of calcium detected on a cardiac CT scan is a helpful diagnostic tool. The findings on cardiac CT are expressed as a calcium score. Another name for this test is coronary artery calcium scoring.

### What are some common uses of the procedure?

The goal of cardiac CT for calcium scoring is to detect coronary artery disease (CAD) at an early stage when there are no symptoms and to determine its severity. It is a screening study that may be recommended by a physician for patients with risk factors for CAD but no clinical symptoms. The procedure is most often suggested for men aged 45 years or older and for women

who are aged 55 and above or who are postmenopausal. Some patients choose to have the test on their own even if their doctors have not recommended it, in order to detect early-stage CAD.

The major risk factors for CAD, other than age, are:

- abnormally high blood cholesterol levels
- a family history of heart disease
- diabetes
- high blood pressure
- cigarette smoking
- being overweight or obese
- being physically inactive

### How should I prepare?

No special preparation is necessary in advance of a cardiac computed tomography (CT) examination. You may continue to take your usual medications, but should avoid caffeine and smoking for four hours before the exam. If your heart rate is 90 beats a minute or higher, you may be given a drug to slow the rate in order to obtain accurate CT images.

You should wear comfortable, loose-fitting clothing to your exam. You may be given a gown to wear during the procedure.

Metal objects including jewelry, eyeglasses, dentures and hairpins may affect the CT images and should be left at home or removed prior to your exam. You may also be asked to remove hearing aids and removable dental work.

Women should always inform their physician or technologist if there is any possibility that they are pregnant.

## What does the equipment look like?

The CT scanner is typically a large machine with a hole, or tunnel, in the center. A moveable examination table slides into and out of this tunnel. In the center of the machine, the x-ray tube and electronic x-ray detectors are located opposite each other on a ring, called a gantry, which rotates around you. The computer that processes the imaging information and monitor are located in a separate room.



## How does the procedure work?

In many ways CT scanning works very much like other x-ray examinations. X-rays are a form of radiation—like light or radio waves—that can be directed at the body. Different body parts absorb the x-rays in varying degrees.

In a conventional x-ray exam, a small burst of radiation is aimed at and passes through the body, recording an image on photographic film or a special image recording plate. Bones appear white on the x-ray; soft tissue shows up in shades of gray and air appears black.

With CT scanning, numerous x-ray beams and a set of electronic x-ray detectors rotate around you, measuring the amount of radiation being absorbed throughout your body. At the same time, the examination table is moving through the scanner, so that the x-ray beam follows a spiral path. A special computer program processes this series of pictures, or slices of your body, to create two-dimensional cross-sectional images, which are then displayed on a monitor.

CT imaging is sometimes compared to looking into a loaf of bread by cutting the loaf into thin slices. When the image slices are reassembled by computer software, the result is a very detailed multidimensional view of the body's interior.

Refinements in detector technology allow new CT scanners to obtain multiple slices in a single rotation. These scanners, called “multislice CT” or “multidetector CT,” allow thinner slices to be obtained in a shorter

period of time, resulting in more detail and additional view capability.

Modern CT scanners are so fast that they can scan through large sections of the body in just a few seconds. Such speed is beneficial for all patients but especially children, the elderly and critically ill.

## How is the procedure performed?

The technologist begins by positioning you on the CT examination table, usually lying flat on your back or possibly on your side or on your stomach. Straps and pillows may be used to help you maintain the correct position and to hold still during the exam.

Electrodes (small metal discs) will be attached to your chest and to an electrocardiograph (ECG) machine that records the electrical activity of the heart. This makes it possible to record CT scans when the heart is not actively contracting.

Next, the table will move quickly through the scanner to determine the correct starting position for the scans. Then, the table will move slowly through the machine as the actual CT scanning is performed.

Patients are periodically asked to hold their breath for periods of 20 to 30 seconds while images are recorded.

When the examination is completed, you will be asked to wait until the technologist determines that the images are of high enough quality for the radiologist to read.

The actual CT scanning is usually completed within 10 minutes.

## What will I experience during and after the procedure?

Most CT exams are painless, fast and easy. With spiral CT, the amount of time that the patient needs to lie still is reduced.

Though the scanning itself causes no pain, there may be some discomfort from having to remain still for several minutes. If you have a hard time staying still, are claustrophobic or have chronic pain, you may find a CT exam to be stressful. The technologist or nurse may offer you a mild sedative to help.

When you enter the CT scanner, special lights may be used to ensure that you are properly positioned. With modern CT scanners, you will hear only slight buzzing, clicking and whirring sounds as the CT scanner revolves around you during the imaging process.

You will be alone in the exam room during the CT scan, however, the technologist will be able to see, hear and speak with you at all times.

After a CT exam, you can return to your normal activities.

## Who interprets the results and how do I get them?

A radiologist, a physician specifically trained to supervise and interpret radiology examinations, will analyze the images and send a signed report to your primary care or referring physician, who will share the results with you.

A negative cardiac CT scan that shows no calcification within the coronary arteries suggests that atherosclerotic plaque is minimal and that the chance of coronary artery disease developing over the next two to five years is very low.

A positive test means that coronary artery disease is present, regardless of whether or not the patient is experiencing any symptoms. The amount of calcification—expressed as a score—may help to predict the likelihood of a myocardial infarction (heart attack) in the coming years.

Calcium Score	Presence of Plaque
0	No evidence of plaque
1-10	Minimal evidence of plaque
11-100	Mild evidence of plaque
101-400	Moderate evidence of plaque
Over 400	Extensive evidence of plaque

## What are the benefits vs. risks?

### Benefits

- Cardiac computed tomography (CT) for calcium scoring is a convenient and noninvasive way of evaluating the coronary arteries.
- Cardiac CT takes little time and causes no pain.
- The exam does not require injection of contrast material and therefore avoids its possible side effects.
- The examination can suggest the presence of CAD even when the coronary arteries are less than 50 percent narrowed. Standard cardiac tests will not reliably detect this level of blockage, and more than half of all heart attacks occur with less than 50 percent narrowing.
- No radiation remains in a patient's body after a CT examination.
- X-rays used in CT scans usually have no side effects.

### Risks

- There is always a slight chance of cancer from radiation. However, the benefit of an accurate diagnosis far outweighs the risk.
- The effective radiation dose from this procedure is about 2 mSv, which is about the same as the average person receives from background radiation in eight months.
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant.
- CT scanning is, in general, not recommended for pregnant women because of potential risk to the baby.
- The results of a Cardiac CT are sometimes positive even though there is no significant blockage of the coronary arteries. As a result, the patient may undergo further tests that are not necessary and these tests might cause side effects.

## What are the limitations of Cardiac CT for Calcium Scoring?

A person who is very obese may not fit into the opening of a conventional CT unit.

Not all calcium deposits in the coronary arteries mean that there is a blockage, and not all blocked arteries contain calcium.

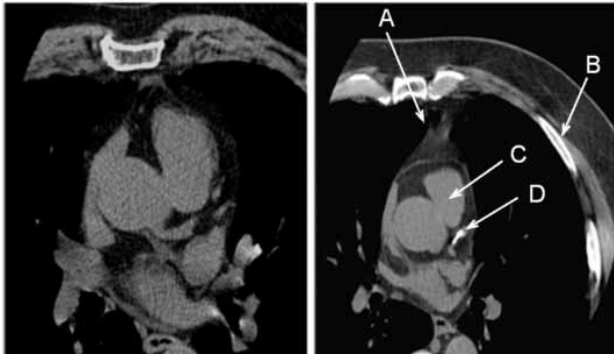
The earliest form of coronary artery disease, soft plaque, cannot be detected by cardiac computed tomography (CT).

Not all health insurance plans cover cardiac CT for calcium scoring.

A high heart rate may interfere with the test. If a patient's heart rate is 90 or more beats per minute, the exam may need to be rescheduled.

Exactly how the calcium score relates to the likelihood of experiencing angina, myocardial infarction, and sudden cardiac death remains uncertain.

Men less than 35 years of age and women younger than 40 are not likely to benefit from cardiac CT for calcium scoring unless there are risk factors such as diabetes or a strong family history of heart disease. Men older than 65 years and women older than 70 are not likely to be treated differently as a result of findings on cardiac CT.



(Left) CT of normal coronary artery.

(Right) Abnormal CT showing calcium in the left coronary artery.

A: sternum

B: rib

C: heart

D: calcium in the coronary artery

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