Calcium is a chemical element that is essential for living organisms.

Most of the calcium within the human body is found in teeth and bone. Small amount, about one percent of total body calcium, is dissolved in the blood.

Undissolved calcium is metallic and hard and is difficult to break or cut with a knife.

When we age, calcium deposits can be found in many parts of our bodies. Calcification of the walls of the arteries is common in people aged 65 and older. Calcification of the breasts is often seen in women after the age of 50.

So, to a certain extent calcification of arteries and internal organs can be regarded as a normal part of aging.

Due to their metallic nature and density, calcium deposits are easily detected by X-ray images. In the early days of cardiac imaging, doctors relied on detecting calcium, as it often was the only feature that stood out on radiographs of the heart.

If arterial calcification is abundant, the aorta and coronary arteries can be outlined on a plain radiographic image. Today these methods have been replaced by more sophisticated modern imaging techniques.
Coronary Artery Disease

The coronary arteries are important vessels that supply blood to the heart muscle. To be able to function normally, heart muscle cells need a continuous supply of blood, delivering important nutrients of which oxygen is most important.

Atherosclerosis, is a chronic inflammatory condition that may cause narrowing of arteries, and rupture of arterial plaques, resulting in blood clotting (thrombosis) and sudden disruption of blood flow. Due to several different reasons, the coronary arteries are very prone to atherosclerosis.

If the supply of blood is disrupted, parts of the heart muscle may die, and will be replaced by scar tissue. This can compromise the ability of the heart to pump blood to the organs of the body.

The term acute heart attack (myocardial infarction) refers to a situation where there is sudden blockage (occlusion) of blood flow in a coronary artery.

In the early 1960’s several risk factors for atherosclerosis and coronary artery disease were defined. Since then it has been repeatedly documented that smoking, lipid disorders and high blood pressure are associated with increased risk. Other conditions that predispose to coronary artery disease are family history, insulin resistance, physical inactivity, mental stress and depression.

Identifying individuals at risk is very important in order to reduce the risk of coronary artery disease. Therefore, knowledge of risk factors and how to reduce their influence is of key importance. The declining death rate from coronary disease seen for the last 35 years can to a large extent be explained by reductions in major risk factors such as blood cholesterol, blood pressure and smoking (1).

Atherosclerotic coronary heart disease is still the most common cause of death in the Western world. Thus far, our ability to screen for this disease has been limited.

Although the usefulness of screening is still debated, assessing the amount of calcium within the walls of the coronary arteries may provide important prognostic information.
Coronary Artery Calcification

Although calcification of the coronary arteries can be regarded as an aging phenomenon, extensive calcification appears to reflect more intense atherosclerosis, higher risk of heart attack, and worse prognosis.

Coronary calcification can be seen in adolescents, although it usually starts later in life.

The calcification is composed of calcium phosphate which is similar to that in bone.

For a long while, arterial calcification was thought to be the result of a degenerative process, but recent evidence suggests that a more active process is involved, possibly resulting from injury or inflammation within the vessel wall.

In June 2000, the American College of Cardiology (ACC) and American Heart Association (AHA) Consensus Panel wrote in the Journal of the American College of Cardiology: “Coronary calcium is part of the development of atherosclerosis; …it occurs exclusively in atherosclerotic arteries and is absent in the normal vessel wall.”

Coronary Artery Calcium Score

In the 1980’s US cardiologists lead by Dr. Arthur Agatston defined a method to assess the amount of coronary artery calcium by using electron beam computed tomography, otherwise known as ultra fast CT scan.

The density of calcium is assessed by the so-called Hounsfield scale which measures density in Hounsfield units. The weighed score multiplied by the area of the coronary calcification provides the calcium score, commonly termed the Agatson score.

The amount of calcium within the walls of the coronary arteries, assessed by the Agatston score, appears to be a better predictor of risk than standard risk factors (2).

A recent study found that progression of coronary calcification, assessed by two scans in 2.5 years, was associated with increased risk of cardiovascular events during a follow-up of more then 7 years (3).

The presence and extent of coronary calcium is first and foremost a marker of the extent of atherosclerosis within the coronary arteries. Nonetheless, it is important to understand that the coronary calcium score does not necessarily reflect the severity of narrowing (the degree of stenosis). Still, a patient with high calcium score is more likely to have a significant narrowing of a coronary artery than a patient with low calcium score.
An individual without coronary artery calcification is very unlikely to have a severe narrowing of a coronary artery (4).

Although cardiovascular events can occur in patients with very low calcium scores, the incidence is very low.

Based on a number of studies, the following definitions are used to relate the coronary artery calcium score to the extent of atherosclerotic coronary artery disease:

- **Coronary calcium score 0**: No identifiable plaque. Risk of coronary artery disease very low (<5%)
- **Coronary calcium score 1-10**: Mild identifiable plaque. Risk of coronary artery disease low (<10%)
- **Coronary calcium score 11-100**: Definite, at least mild atherosclerotic plaque. Mild or minimal coronary narrowings likely.
- **Coronary calcium score 101-400**: Definite, at least moderate atherosclerotic plaque. Mild coronary artery disease highly likely. Significant narrowings possible
- **Coronary calcium score > 400**: Extensive atherosclerotic plaque. High likelihood of at least one significant coronary narrowing.

When interpreting coronary artery calcium score it is very important to consider age and gender. For example 50% of white males aged 70 have a calcium score higher than 14.5 and 50% of white females aged 70 have a calcium score above 13. There is a calculator available [here](#) that provides coronary calcium score distribution based on age, gender and ethnicity.

**How Is Coronary Calcium Assessment Performed?**
To begin with, coronary calcium assessment with CT was made possible with the development of the electron-beam CT scanner in the late 1980’s. The speed of this machine was much higher than that of existing scanners. The high speed made it possible to “freeze” heart motion to allow measurements of calcium in the coronary arteries.

Lately, ultrafast spiral CT has been used to assess coronary calcium. This technique makes the scanning time very short. Often a scanning length of around 10 seconds is used.

The patient usually needs no specific preparation. Fasting is not necessary. As high heart rate may reduce imaging quality, patients are often asked to refrain from smoking and drinking coffee before the scan. Sometimes beta blockers are administered to slow heart rate.

Many experts have expressed concerns about the radiation involved with the CT scan. It has been estimated that there may be an increase in radiation-induced cancer risk with repeated procedures (5).
What to Do About Extensive Coronary Calcification?

There is no specific treatment available that lowers coronary calcium.

One randomized placebo controlled trial (6) did not find any significant benefit with atorvastatin (cholesterol lowering drug), vitamin C and vitamin E in patients with high coronary artery calcium score.

Although blood levels of cholesterol were reduced, there was no effect on progression of coronary calcium score. Atherosclerotic cardiovascular events were fewer in the drug treatment group compared with placebo, but the difference was not statistically significant. However, there was a greater treatment effect in a subgroup with coronary calcium scores above 400.

Treatment of individuals with high calcium scores should aim at reducing risk. This involves treating lipid disorders, high blood pressure and diabetes if present. Refraining from smoking is essential. Regular, moderate exercise is advised. Due to the overwhelming evidence of benefit in individuals with atherosclerotic heart disease, treatment with aspirin and statins is generally advised.

If extensive calcification is present, further evaluation may be needed. Stress test associated with nuclear and echocardiographic imaging techniques is often performed. **Coronary catheterization** with angiography of the coronary arteries may be indicated to assess the severity and extent of coronary narrowing.