Calcium crystal diseases

including acute CPP crystal arthritis (pseudogout) and acute calcific tendinitis.

This booklet provides information and answers to your questions about these conditions.
What are calcium crystal diseases?

Deposits of two types of calcium crystals can cause attacks of painful swelling in and around your joints. In this booklet we’ll explain the main facts about calcium crystal diseases, including the differences between the main types, the causes, symptoms and who gets them. We’ll also look at what you can do to manage and treat them, from simple self-help measures to the range of drug treatments that are available.

At the back of this booklet you’ll find a brief glossary of medical words – we’ve underlined these when they’re first used.

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What’s inside?

2 Calcium crystal diseases at a glance

4 What are calcium crystal diseases?

10 What are the symptoms of calcium crystal diseases?

12 Who gets calcium crystal diseases?

12 What causes calcium crystal diseases?
  – What is a crystal?
  – Why do people get calcium crystal deposits?

14 What is the outlook?

14 How are calcium crystal diseases diagnosed?
  – What tests are there?

15 What treatments are there for acute attacks?
  – Drugs
  – Joint aspiration and injection

17 Self-help and daily living
  – Exercise
  – Diet and nutrition
  – Pain management

20 What else should I know about calcium crystal diseases?
  – Is osteoarthritis with calcium crystals different from osteoarthritis without calcium crystals?

21 Glossary

23 Where can I find out more?

24 We’re here to help
What are calcium crystal diseases?

Deposit of different types of calcium crystals can cause sudden attacks of painful inflammation in and around your joints. Calcium pyrophosphate (CPP) crystals deposit within the joints themselves and can cause a condition called acute CPP crystal arthritis (sometimes previously called ‘pseudogout’). Apatite crystals can occur inside joints, but they also deposit in tendons and cause a condition known as acute calcific tendinitis. Both CPP and apatite crystals more commonly form in joints that have osteoarthritis.

What are the symptoms?

Symptoms of acute CPP crystal arthritis include:

• sudden pain and stiffness in the affected joint (most commonly the knee)
• swelling and tenderness
• red, inflamed skin over the joint
• a fever (raised temperature) and feeling unwell.

These tend to last from several days to two weeks before completely settling.

Symptoms of acute calcific tendinitis include:

• painful swelling around the joint (most commonly the shoulder)
• tenderness around the joint, which may be severe.

These usually settle back to normal after two to four weeks.

What causes them?

Calcium crystal diseases can be caused by:

• chemical imbalances relating to calcium pyrophosphate, which can lead to an increase in crystal production
• changes in cartilage due to osteoarthritis encouraging calcium crystal formation
• crystals being shaken loose into joints or tendons by injuries to your joint or tendon, or by having a fever (for example due to a chest infection) or a stress to your body (such as an operation).
Deposits of calcium crystals in joints or tendons can cause pain and inflammation.

**What treatments are there?**

Although the attacks of inflammation clear up by themselves, some treatments can help with the pain, inflammation and length of the attack. These include:

- **non-steroidal anti-inflammatory (NSAIDs)** to ease pain
- colchicine tablets to reduce the inflammation caused by the crystals
- using ice packs to reduce inflammation and doing regular exercise to help with recovery
- aspiration (draining fluid from the inflamed joint or bursa) and then an injection of a small amount of long-acting steroid to quickly reduce pain and shorten the length of the attack.
What are calcium crystal diseases?

It’s normal for calcium crystals to be found in parts of your body, for example, your bones and teeth, but sometimes they can form in other parts of your body. This can cause acute attacks of inflammation (where your body’s tissues become hot, swollen and painful). This process is described as a calcium crystal disease. The main crystals that cause problems are calcium pyrophosphate crystals and apatite crystals:

**Calcium pyrophosphate crystals** can form in cartilage. If these crystals then shake loose (a process called crystal ‘shedding’, see below for more information), they can cause inflammation in the lining of the affected joint and trigger an attack of joint pain and swelling. This is called **acute calcium pyrophosphate (CPP) crystal arthritis**. The old term for this was ‘pseudogout’, which literally means ‘false-gout’. It got this name because the attack of inflammation resembles gout, a completely different condition which is caused by urate crystals rather than calcium pyrophosphate crystals. The reasons why people get acute CPP crystal arthritis and gout are quite different, although they can cause similar symptoms. Figure 1 shows an attack of acute CPP crystal arthritis in the knee.

When calcium pyrophosphate crystals are deposited in the joint cartilage of people with osteoarthritis, this is called osteoarthritis with calcium pyrophosphate crystal deposition, or osteoarthritis with CPPD for short (see ‘What else should I know about calcium crystal diseases?’ for more information).

**Apatite crystals** can form in tendons, and this is called calcific tendinitis. **Acute calcific tendinitis** is sometimes called acute periarthritis. This usually affects the supraspinatus tendon that helps move your shoulder, but tendons around your hip, hand or elsewhere in your body may also be affected. Figure 2 shows an affected shoulder.

An unusual build-up of calcium crystals is much more common in the cartilage within your joints than in your tendons. This is called cartilage calcification, or **chondrocalcinosis**, and is usually caused by calcium pyrophosphate crystals,
Area around knee will appear hot, swollen, very tender and painful.

Collar bone (clavicle)
Part of the shoulder blade (acromion)
Supraspinatus muscle
A deposit of crystals in the supraspinatus tendon
Shoulder blade (scapula)
Upper arm (humerus)

Figure 1
Acute CPP crystal arthritis of the knee

Figure 2
Calcific tendinitis of the shoulder
although it’s occasionally caused by apatite crystals or a mix of both types of crystals. Chondrocalcinosis affects the soft, slippery hyaline cartilage attached to the end of the bone, or the tougher form of cartilage (fibrocartilage) which makes up the free spacers in joints such as your knee. This is shown in Figure 3.

Figure 4 shows the different types of calcium crystal disease and which crystals are involved.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Also known as</th>
<th>Type of crystal usually involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute calcium pyrophosphate crystal arthritis</td>
<td>Acute CPP crystal arthritis, pseudogout</td>
<td>Calcium pyrophosphate</td>
</tr>
<tr>
<td>Osteoarthritis with calcium pyrophosphate deposition</td>
<td>Osteoarthritis with CPPD</td>
<td>Calcium pyrophosphate</td>
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<tr>
<td>Calcific tendinitis</td>
<td></td>
<td>Apatite</td>
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<tr>
<td>Acute calcific tendinitis</td>
<td>Acute periarthritis</td>
<td>Apatite</td>
</tr>
<tr>
<td>Chondrocalcinosis</td>
<td>Cartilage calcification</td>
<td>Calcium pyrophosphate, apatite and sometimes both</td>
</tr>
</tbody>
</table>
Figure 5
Shedding of crystals from cartilage into the joint capsule

Figure 6
Shedding of crystals from a tendon in the shoulder
In many cases calcific tendinitis and chondrocalcinosis occur in otherwise normal tendons and cartilage, without causing any symptoms at all. When calcium crystals are embedded deep within the tendon or cartilage they usually don’t affect the way these tissues work. Also, because they’re so deep within these tissues the crystals don’t come into contact with your blood cells or the proteins involved in your immune system, so they don’t cause any inflammation. Many people have these crystal deposits for years without any problems at all.

However, if the crystals move from their protected site within the cartilage or tendon they become exposed to your immune system and can then cause attacks of severe inflammation. This movement of crystals out of surrounding tissues into the joint cavity, or out of a tendon into the surrounding soft tissues, is called crystal shedding (see Figures 5 and 6).
What are the symptoms of calcium crystal diseases?

In this section we’ll look at the symptoms for the two most common types of calcium crystal disease: calcium pyrophosphate (CPP) crystal arthritis (see Figure 7), and acute calcific tendinitis (see Figure 8).

**Figure 7**
The symptoms of acute CPP crystal arthritis

- **Sudden pain in affected joint (most commonly knee)**
- **Affected joint becomes swollen, tender, stiff and painful**
- **Generally feeling unwell**
- **Lasts several days to two weeks before completely settling**
- **Raised temperature**
The symptoms of acute calcific tendinitis

Painful swelling around joint

Settles back to normal after two to four weeks

Usually affects the shoulder

Large crystal deposits can cause tendon to bulge

Redness and tenderness over affected joint

Acute calcific tendinitis

Figure 8
The symptoms of acute calcific tendinitis
Who gets calcium crystal diseases?

Acute CPP crystal arthritis usually affects people in late middle-age or the elderly, and it’s rare if you’re under the age of 60. Men and women are equally affected. The knee is the most commonly affected joint, but it can also affect the wrist, shoulder, ankle and occasionally other joints. Usually just one joint is affected at any one time.

An attack of acute CPP crystal arthritis can happen in a joint that’s already affected by osteoarthritis (see section ‘What else should I know about calcium crystal diseases?’).

Acute calcific tendinitis usually affects the shoulders of young or middle-aged adults. Again, men and women are equally affected.

What causes calcium crystal diseases?

In order to understand calcium crystal diseases, we need to have a closer look at the crystals involved.

What is a crystal?

All crystals are special in the way they’re made. The very small particles (atoms) that make a crystal are arranged in a regular repeating pattern, which makes crystals very hard and difficult to break down. This is put to good use in nature – for example, seashells and bones are hard and strong because they contain a lot of calcium crystals. Crystals of the same chemical make-up tend to have repeating geometric shapes, as shown in Figure 9.

Figure 9
Crystals of calcium pyrophosphate

The atoms making up these crystals are arranged in a repeating pattern, causing sharp angles.
However, the hard, sharp angles of calcium crystals make them rub and grind down things that are in contact with them. Also, their rough surface has a strong electrical charge, which can injure cells and trigger your immune system. These are the ways that crystals can cause inflammation in parts of your body.

**Why do people get calcium crystal deposits?**

Even if you’re perfectly healthy, the chemicals which form crystals may be present in your blood, urine or soft tissues. Crystals don’t usually form in your body’s tissues and fluids because there are other substances present which stop them developing. These are called crystal inhibitors. Your body also contains other substances that can actually make it more likely that crystals will form – these are called crystal promoters.

In someone with chondrocalcinosis or calcific tendinitis the levels of these chemicals in the body may well be the same as for anyone else. The most likely reason crystals form is because the balance between inhibitor and promoter substances changes. This balance tends to change as part of normal ageing but also because of osteoarthritis. The change in balance is mainly localised to the joints or tendons affected and isn’t a widespread problem throughout the body.

Other possible causes of calcium crystal disease may include:

**Metabolic diseases** which affect the regulation of calcium or pyrophosphate levels, including:

- hyperparathyroidism (overactivity of the parathyroid glands)
- haemochromatosis (also known as iron-storage disease)
- hypomagnesaemia (magnesium deficiency).

**Genetic factors** – recent research has found that an abnormality of a particular gene (the ANKH gene) may lead to the production of too much pyrophosphate, which can result in widespread calcium crystal depositing and repeat attacks of acute CPP crystal arthritis at an
unusually young age (even 20s or 30s). In other families different genetic factors may be involved, which aren’t yet fully understood.

There can be other uncommon causes of calcific tendinitis, such as the kidneys not working properly or high calcium levels.

**What is the outlook?**

Typical attacks of acute CPP crystal arthritis gradually settle on their own, without needing treatment. You may notice the swelling going down within a week, though your joints may be very painful for the first few days. Affected joints may take up to two to three weeks to return to normal. This process is slightly longer for attacks of acute calcific tendinitis, which can take up to four weeks to get back to normal.

**How are calcium crystal diseases diagnosed?**

Acute CPP crystal arthritis can appear very similar to both acute gout and an infection within the joint. It’s very important you go and see your doctor when you first have an attack because they’ll probably need to carry out some tests to rule out other conditions.

**What tests are there?**

There are several tests that can be carried out to help make a diagnosis of calcium crystal disease, including:

- testing your joint fluid for crystals and infection
- x-rays to show any calcification in your joint cartilage or tendon
Your doctor may prescribe NSAIDs, which can help to ease the pain of an acute attack.

What treatments are there for acute attacks?
Attacks of acute CPP crystal arthritis and acute calcific tendinitis usually settle on their own without any treatment; however, because they’re very painful and distressing the attacks need treatment aimed at relieving pain, reducing inflammation and shortening the length of the attack.

Drugs

Non-steroidal anti-inflammatory drugs (NSAIDs)
Non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen, naproxen and diclofenac may ease the pain of an acute attack. They’ll usually be prescribed at the lowest effective dose for the shortest period of time to reduce the risk of side-effects, but for intense pain and inflammation these drugs need to be given at their top dose, rather than starting with a low dose and slowly working upwards.

NSAIDs can cause digestive problems (stomach upsets, indigestion or damage to the lining of the stomach), so in most cases they’ll be given along with a drug called a proton pump inhibitor (PPI), which will help to protect your stomach. NSAIDs also carry an increased risk of heart attack or stroke. Although the increased risk is small, your doctor will be cautious about prescribing NSAIDs if there are other factors that may increase your overall risk – for example, smoking, circulation problems, high blood pressure, high cholesterol or diabetes. Your doctor may decide not to prescribe NSAIDs if you have certain other medical problems such as reduced kidney function or a previous stomach ulcer.

Colchicine
Colchicine can reduce the symptoms and severity of acute CPP crystal arthritis. It works by reducing the interaction between the crystals and your immune system. The usual dose of colchicine is 0.5 mg two to four times a day, and it’s usually effective and very well tolerated. The most common side-effect is loose bowel motions, but high doses can cause very severe diarrhoea.

See Arthritis Research UK drug leaflets Drugs and arthritis; Non-steroidal anti-inflammatory drugs.
Your doctor may use a needle and syringe to take fluid out of your joint. This is called aspiration, and it can very quickly reduce the high pressure in the joint which is causing the extreme pain.

This is a relatively simple, quick procedure that usually brings fast relief.
Joint aspiration and injection
Your doctor may use a needle and syringe to take fluid out of your joint. This is called aspiration, and it can quickly reduce the high pressure in the joint which is causing the extreme pain. This procedure is fairly simple and quick, and it usually brings fast relief. Usually, once the fluid has been drawn out your doctor will inject a small amount (1–2 ml) of a long-acting steroid back into your joint through the same needle. This helps to reduce inflammation in the lining of your joint and prevent the build-up of more fluid. This process can also help if acute calcific tendinitis has caused a large build-up of fluid in your subacromial bursa or subdeltoid bursa (see Figure 10).

Self-help and daily living
Exercise
Following an attack of inflammation it’s important that you get the affected joint and muscles moving through their normal range of motion as soon as possible. Doing a small amount of exercise on a regular basis will prevent any weakening or wasting of surrounding muscle and help the inflamed tissues return to normal. Your physiotherapist can help you and give expert advice. If you have osteoarthritis with CPPD, you should do regular strengthening exercises and aerobic exercises.

See Arthritis Research UK booklets
Keep moving; Physiotherapy and arthritis.

Figure 10
Swelling in the bursa at the shoulder

Swelling caused by fluid build-up in the subdeltoid bursa
Diet and nutrition
Crystal deposition isn’t usually affected by your diet. Special diets and supplements are needed only for the very few people who have a metabolic disease (such as magnesium deficiency) or kidney problems. For general health and well-being, however, you should eat a well-balanced diet and avoid becoming overweight. This is particularly important if you have osteoarthritis of the knee or hip.

Pain management
Applying an ice pack around the painful joint is a very quick and safe way of taking the edge off severe pain. You can buy commercially made versions but you can also make up your own pack using a large pack of frozen peas or ice cubes wrapped up in a damp towel, to protect your skin.

See Arthritis Research UK booklet
Diet and arthritis.

See Arthritis Research UK booklet
Pain and arthritis.

It’s important that you get the affected joint and muscles moving through their normal range of motion as soon as possible.
Arthritis Research UK
Calcium crystal diseases
What else should I know about calcium crystal diseases?

Is osteoarthritis with calcium crystals different from osteoarthritis without calcium crystals?
Many people with osteoarthritis, particularly of the knee, have calcium pyrophosphate crystals in their affected joint cartilage. This combination is called osteoarthritis with calcium pyrophosphate crystal deposition (osteoarthritis with CPPD for short).

Calcium pyrophosphate crystals tend to make your osteoarthritis more troublesome and severe. The affected joints are likely to become more painful and stiff than an osteoarthritic joint without calcium crystals. The narrowing of cartilage and thickening of bone processes associated with osteoarthritis are also more likely to progress over several years when crystals are present, rather than stay the same. These joints may also develop attacks of acute CPP crystal arthritis.

Many people with osteoarthritis have calcium pyrophosphate crystals in their affected joint cartilage.
Glossary

**Acute calcific tendinitis** (acute periarthritis) – an attack of pain and inflammation caused by the shedding of crystals from a tendon which has crystals in it.

**Acute CPP crystal arthritis** – the shorthand term for acute calcium pyrophosphate crystal arthritis. The calcium pyrophosphate crystals in acute CPP crystal arthritis cause severe joint inflammation which comes on suddenly. It used to be known as pseudogout.

**Aerobic exercise** – any exercise that increases your pulse rate and makes you a bit short of breath.

**Apatite** – a shorthand term for various calcium phosphate crystals (mainly hydroxyapatite) that are present in bones but can also form in joints, tendons and occasionally other tissues.

**Bursa** – a small pouch of fibrous tissue lined (like a joint) with a synovial membrane. Bursae help to reduce friction; they occur where parts move over one another, for example where tendons or ligaments pass over bones. Others, however, form in response to unusual pressure or friction – for example, with a bunion.

**Calcific tendinitis** – a deposit of apatite crystals causing inflammation within a tendon.

**Calcium pyrophosphate (CPP)** – the crystal that’s the most likely to be deposited in cartilage (chondrocalcinosis). Shedding of these crystals causes acute CPP crystal arthritis. (See also ‘pyrophosphate’.)

**Cartilage** – a layer of tough, slippery tissue that covers the ends of the bones in a joint. It acts as a shock-absorber and allows smooth movement between bones.

**Chondrocalcinosis** (cartilage calcification) – the depositing of calcium crystals within cartilage. The crystal which usually causes this is calcium pyrophosphate, although apatite or a mixture of calcium pyrophosphate and apatite may also do this.

**Gout** – a condition similar to acute calcium pyrophosphate crystal arthritis but which is caused by urate crystals rather than calcium crystals. It often affects the big toe.

**Haemochromatosis (iron-storage disease, or bronze diabetes)** – a disease in which there’s excessive absorption and storage of iron.

**Hyperparathyroidism** – overactivity of the parathyroid glands that leads to high levels of calcium in the blood and tissues.

**Hypomagnesaemia** – magnesium deficiency. This may result from a ‘leaky’ kidney (losing too much magnesium) or from bowel problems that interfere with the absorption of magnesium from our food.
Immune system – the tissues that enable the body to fight and resist infection and disease. They include the thymus (a gland that lies behind the breastbone), the bone marrow and the lymph nodes.

Inflammation – a normal reaction to injury or infection of living tissues. The flow of blood increases, resulting in heat and redness in the affected tissues, and fluid and cells leak into the tissue, causing swelling.

Non-steroidal anti-inflammatory drugs (NSAIDs) – a large family of drugs prescribed for different kinds of arthritis that reduce inflammation and control pain, swelling and stiffness. Common examples include ibuprofen, naproxen and diclofenac.

Osteoarthritis – the most common form of arthritis (mainly affecting fingers, knees, hips), causing cartilage thinning and bony overgrowth.

Periarthritis – inflammation near to, but just outside, a joint.

Physiotherapist – a trained specialist who helps to keep your joints and muscles moving, helps ease pain and keeps you mobile.

Proton pump inhibitor (PPI) – a drug that acts on an enzyme in the cells of the stomach to reduce the secretion of gastric acid. They’re often prescribed along with non-steroidal anti-inflammatory drugs (NSAIDs) to reduce side-effects from the NSAIDs.

Pyrophosphate – this substance is produced as a by-product of cell metabolism, and may combine with calcium to form calcium pyrophosphate crystals.

Subacromial bursa – the fluid-filled sac under the acromion bone at the shoulder.

Subdeltoid bursa – the fluid-filled sac under the large deltoid muscle at the shoulder.

Tendon – a strong, fibrous band or cord that anchors muscle to bone.

Urate – a salt of uric acid, which forms as foods are digested and old cells are broken down within the body. It’s normally expelled in the urine but can sometimes build up and form crystals which are deposited in the joints or under the skin.

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Self-help and daily living
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- Non-steroidal anti-inflammatory drugs

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Arthritis Research UK
Copeman House
St Mary’s Court
St Mary’s Gate, Chesterfield
Derbyshire S41 7TD
Phone: 0300 790 0400
www.arthritisresearchuk.org

Related organisations
The following organisations may be able to provide additional advice and information:

Arthritis Care
Floor 4, Linen Court
10 East Road
London N1 6AD
Phone: 0207 380 6500
Helpline: 0808 800 4050
Email: info@arthritiscare.org.uk
www.arthritiscare.org.uk
We’re here to help

Arthritis Research UK is the charity leading the fight against arthritis. We’re the UK’s fourth largest medical research charity and fund scientific and medical research into all types of arthritis and musculoskeletal conditions. We’re working to take the pain away for sufferers with all forms of arthritis and helping people to remain active. We’ll do this by funding high-quality research, providing information and campaigning.

Everything we do is underpinned by research.

We publish over 60 information booklets which help people affected by arthritis to understand more about the condition, its treatment, therapies and how to help themselves.

We also produce a range of separate leaflets on many of the drugs used for arthritis and related conditions. We recommend that you read the relevant leaflet for more detailed information about your medication.

Please also let us know if you’d like to receive our quarterly magazine, Arthritis Today, which keeps you up to date with current research and education news, highlighting key projects that we’re funding and giving insight into the latest treatment and self-help available.

We often feature case studies and have regular columns for questions and answers, as well as readers’ hints and tips for managing arthritis.

Tell us what you think

Please send your views to: feedback@arthritisresearchuk.org or write to us at: Arthritis Research UK, Copeman House, St Mary’s Court, St Mary’s Gate, Chesterfield, Derbyshire S41 7TD

A team of people contributed to this booklet. The original text was written by Prof. Mike Doherty, who has expertise in the subject. It was assessed at draft stage by consultant rheumatologist Dr Paul Creamer and senior lecturer in rheumatology Dr Ian Giles. An Arthritis Research UK editor revised the text to make it easy to read, and a non-medical panel, including interested societies, checked it for understanding. An Arthritis Research UK medical advisor, Dr Sharif Uddin, is responsible for the content overall.
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• taking part in a fundraising event
• making a donation
• asking your company to support us
• buying products from our online and high-street shops.

To get more actively involved, please call us on 0300 790 0400, email us at enquiries@arthritisresearchuk.org or go to www.arthritisresearchuk.org