Geochemistry test can identify osteoporosis earlier than current 'gold-standard' test

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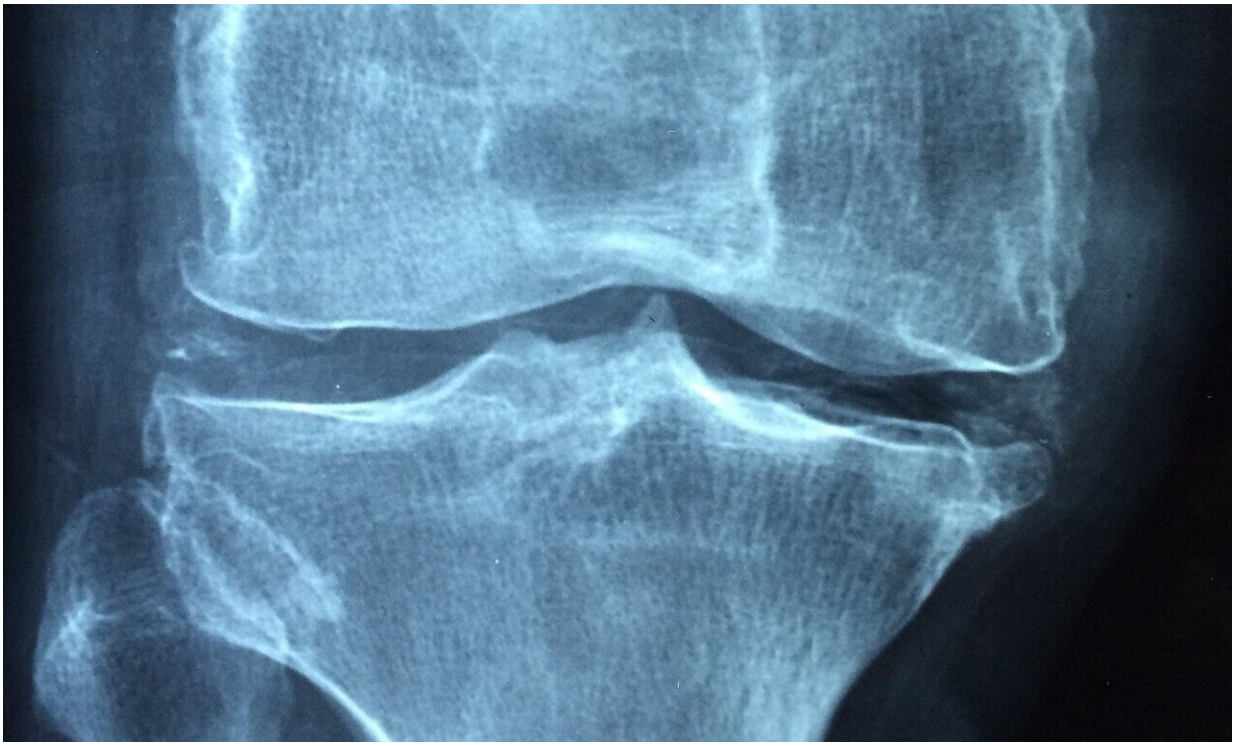

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In a novel collaboration, clinicians and geochemists have developed a test that can show the presence of osteoporosis before it has a noticeable clinical effect on bones. The methods are still being refined, but initial results show that it is more sensitive than the standard DXA osteoporosis scans, and can identify the condition earlier. Researchers are now

working to develop the test for routine clinical use. This work is presented at the Goldschmidt conference, amd the presentation includes work published in the peer-reviewed journal *Bone Reports*.

Lead researcher Dr. Anton Eisenhauer (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany), said, "Bones are made of calcium and phosphorus, with organic components like the protein collagen. About 99% of the body's calcium is found in bones, but this is continually being absorbed and resorbed: The calcium balance of bone can be seen by monitoring calcium isotope composition in blood and urine. We have developed a test that measures and identifies the type of calcium in the blood and in urine—this originates from the bones, and this in turn indicates what's happening in the bones."

The new system was developed out of a standard technique for measuring trace elements and their isotopes in geochemistry. Geochemists routinely identify and quantify elements with different stable isotopes (atoms with different numbers of neutrons). Dr. Eisenhauer is a geochemist, and normally works on analyzing coral shells. He said, "This is really an example of a clinical test coming out of very sophisticated science. I came to this through my work in measuring calcium in corals, but one of the first applications of this technique was a NASA-sponsored project to measure and anticipate bone loss in astronauts."

The researchers studied samples from a group of 80 women, 14 of whom had osteoporosis (as measured by the DXA test). They found that the ratio of calcium-44 to calcium-42 ($^{44}Ca/^{42}Ca$) was significantly lower in the blood and the urine of women with osteoporosis. "There were significant differences in the ratios of these two calcium isotopes if you had osteoporosis," said Eisenhauer.

Osteoporosis happens when bones become less dense, making them

weaker and more prone to fracture. This mainly affects women, especially after the menopause. The standard osteoporosis test uses X-rays to measure the density of two bones, usually the hip and spine.

"One of the beauties of the new method is that it measures calcium in the blood or urine, and so we get a picture of what's happening in the whole skeleton, not just the bone and spine," said clinical lead, Dr. Rukshana Shroff (Consultant Nephrologist, Great Ormond Street Hospital for Children NHS Foundation Trust, London). "Importantly, we have found that we don't need to wait until bones become weaker to see the changes caused by calcium loss. This test allows us to see bones losing calcium more or less in real time, which means that we can pick up osteoporosis earlier and treat it."

The initial results showed that the test picked up 100% of the osteoporosis cases found by DXA. It seemed to overestimate the number of women diagnosed with osteoporosis who did not have the condition in comparison to DXA, but a two-year follow-up showed that in fact, many of these women went on to develop the disease.

"This means that it's likely to be better at identifying the condition than the current method, but the work needs to be repeated with a bigger sample so we can be sure just how selective the test is," said Eisenhauer. "The test is already being used in routine settings. However, it's still expensive due to the more sophisticated sample preparation and the use of high resolution plasma mass spectrometers, but we anticipate the price will drop with increasing use—this happened even with DXA scanners when they were introduced. It's likely that the first practical use of these tests will be to measure how bone recovers when treated with bone building drugs. No other method can show this so sensitively and in a reasonable time."

In the U.S., around 10 million people have osteoporosis and 44 million

have low bone density. Osteoporosis affects the bones of around 22 million people in the EU. About 85% of these people are women. It has a huge financial impact, anticipated to cost the six major European countries nearly €47 billion every year. This will increase as the population ages. Osteoporosis can be treated, but early diagnosis is important.

Professor Jon Tobias, professor of rheumatology at the University of Bristol, who was not involved in the study, said, "It's interesting that technology from earth sciences designed to measure trace elements have the potential for medical application such as diagnosing osteoporosis, but more research is needed before any firm conclusions can be reached."

More information: A. Eisenhauer et al. Calcium isotope ratios in blood and urine: A new biomarker for the diagnosis of osteoporosis, *Bone Reports* (2019). DOI: 10.1016/j.bonr.2019.100200

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