What teeth can reveal about the secret lives of our ancestors

August 29 2017, by Ian Towle

Upper jaw of Paranthropus robustus, which lived 1.2-1.8m years ago. Credit: Ian Towle, Author provided

Old tools and bones can reveal a lot about our ancestors. But when it comes to what was going on inside their bodies – such as what they ate and how healthy they were – nothing can really beat a well-preserved row of teeth.

Teeth are extremely valuable as they are exposed directly to the

environment we live in – anything we consume or breathe comes directly into contact with them. And, most importantly, they are hard enough to preserve really well over time.

Amazingly, the same dental problems that are common today, such as tartar, abscesses, gum disease and cavities, were also present in the past – and all give slightly different insights into diet and health.

For example, cavities are extremely common in most areas of the world today. In pre-agricultural societies, 1-5% of teeth typically had a cavity. Our ancestors or relatives Homo naledi (living 236,000-350,000 years ago), Paranthropus robustus (1.2-1.8m years ago) and Homo erectus (about 2m years ago), had cavity rates of 1.36%, 2.56% and 4.55% respectively – demonstrating just how far back in time toothaches go.

High cavity rates generally suggest a diet containing high levels of certain carbohydrates. For example, Neanderthals had a relatively low rate of cavities – less than 1%. This is thought to be due to a diet containing tough foods and meat which are items that can actively limit cavity formation. On the opposite end of the spectrum a 14,000-year-old hunter-gatherer human population from Morocco had cavities in 50% of teeth. This is thought to be due to heavy consumption of wild plants that are rich in fermentable carbohydrates.
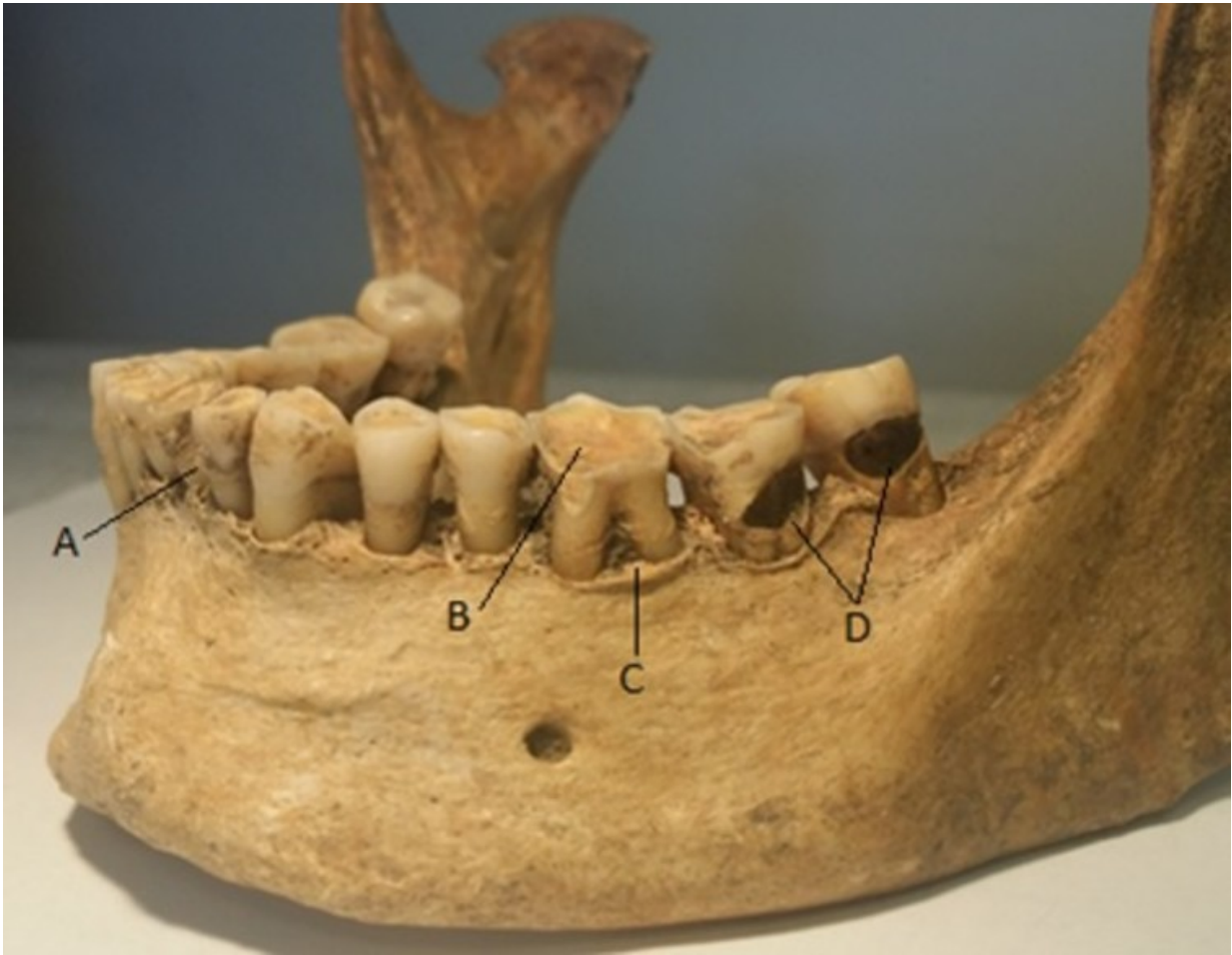
Dental pathology and wear on the mandible of a medieval individual. A: calculus; B) heavy/angled wear; C) periodontal disease; D) cavities. Credit: Ian Towle, Author provided

Wear on the teeth can also provide insight. The most severe tooth wear today is usually caused by erosion, with acidic foods and drinks the main culprits. However, in the past it was tough and hard foods – as well as grit on food items – that caused the most wear. Microscopic differences on tooth surfaces, such as specific patterns of small scratches and pits, depend on the foods consumed.

For example, a recent study of such microwear revealed that Australopithecus afarensis, our 4m-year-old direct ancestor or close relative, probably ate mostly grass and leaves. Meanwhile early members of our own genus, Homo habilis and Homo erectus, which lived about 2m years ago, seem to have eaten a broader diet which was likely to have included more meat.

Chipping caused by consuming hard objects also helps determine what a species ate. This is because certain foods create specific patterns of chipping. For example, we recently discovered that Homo naledihad an unusually high chipping rate, on their back teeth in particular. This could mean that they specialised in eating certain foods such as nuts, or tubers with grit sticking to the surface.

Humans also have a tendency to use their teeth as tools. This can create notches and grooves which often give insight into the behaviour performed. Even our fossil relatives have such marks on their teeth. These include "toothpick grooves" which have been found in Neanderthals and other closely related fossil species. This is quite amazing as it shows such early ancestors were quite sophisticated, using sticks to remove bits of food from their teeth.

Two of the earliest examples of cavities (Homo erectus). Credit: Ian Towle, Author provided

Severe illness

The outer layer of a tooth, called enamel, stays virtually unchanged during life. If an individual is ill or malnourished during the first few years of life, the formation of enamel will be disrupted and therefore be permanently etched on any tooth forming at the time. On a population level these defects, called enamel hypoplasia, can give insight into the health of a group. Extremely high levels suggest extensive periods of starvation or disease.

Defects are relatively common, even today, and are usually small grooves or a few scattered pits. Occasionally, the illness is so severe that

large areas of enamel may be completely missing. This is thought to be caused by only the most severe stresses during childhood. These defects also often have specific characteristics depending on the cause, such as [congenital syphilis](#) and certain genetic conditions.

In a recent paper, my colleagues and I presented one of the [earliest example of such severe defects](#). The individual comes from a Roman mass grave in Gloucester, UK, and lived about 2,000 years ago. Given the severity of the defects and lack of similar ones in earlier populations it may suggest considerable care was needed to overcome this episode. The defects found on her teeth do not resemble those caused by congenital syphilis or a genetic condition and instead were caused by an unknown disturbance, likely an illness or malnutrititon.
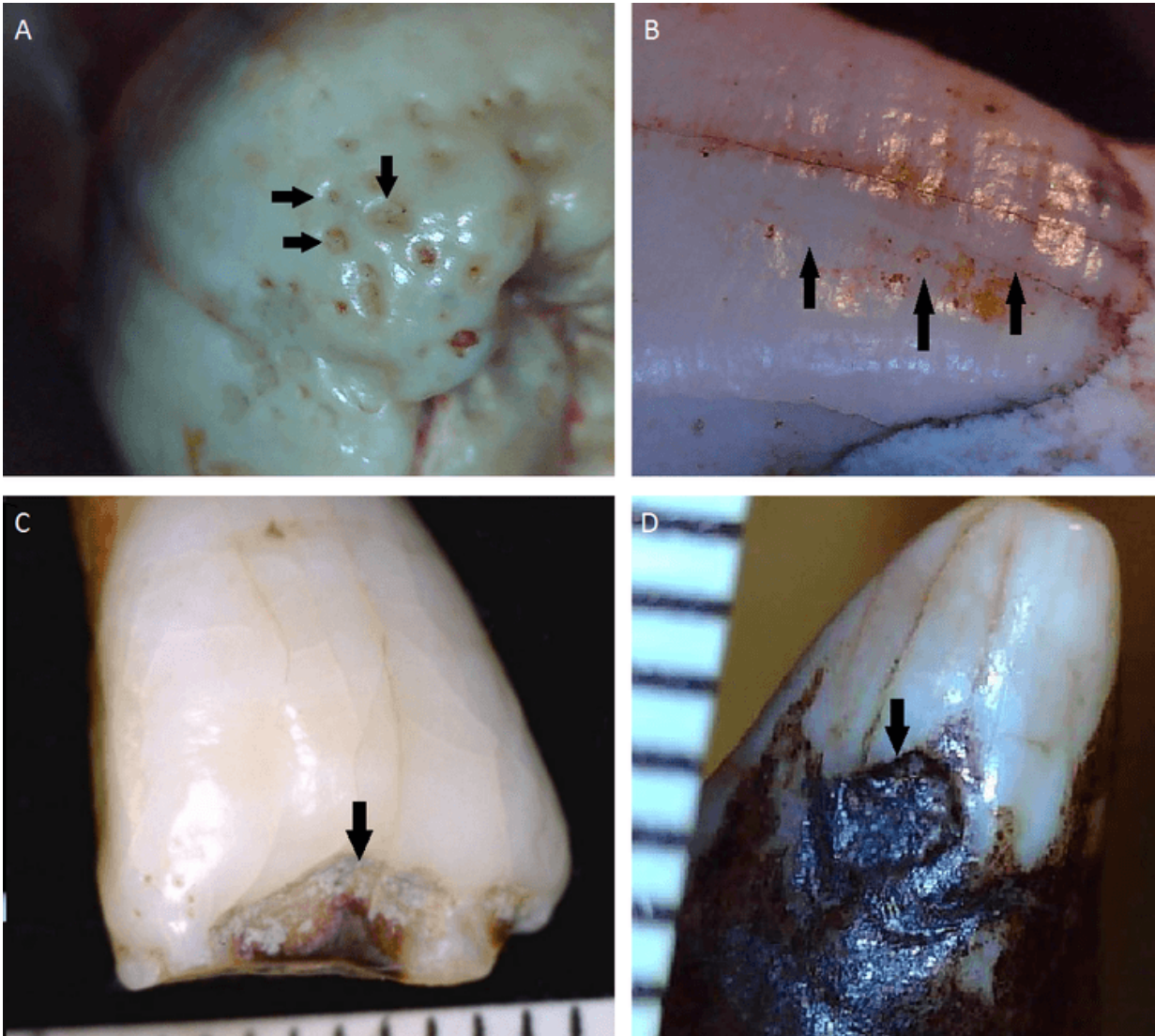
Enamel hypoplasia examples. A) pitting-form (Australopithecus africanus); B) linear-form (Homo naledi). C) plane-form (human); D) localised (gorilla). Credit: Ian Towle, Author provided

By comparing the position of defects on the different teeth, it is possible to give an accurate age at which this young girl would have experienced the illness. She would have been around the age of one and a half, with the way the enamel sharply returned to normal suggesting she may have

quickly recovered. That said, some further pitting defects on later developing teeth suggests she continued to be in poor health. Remarkably she went on to live for 15 years, eventually dying of smallpox.

Remaining puzzles

We can also analyse teeth to look for particular isotopes (atoms with more neutrons in the nucleus), which can reveal more about the type of foods consumed. Tooth shape and material stuck in tartar can also give valuable information. But while teeth can help solve many puzzles, they can throw up questions too. For example, interpreting results can be difficult and often different techniques can result in different conclusions.

One mystery that analysing teeth may help us solve is the fate of [Paranthropus robustus](link) – a fossil relative of ours living 1.8-1.2m years ago in South Africa. It had enormous back teeth and likely ate large amounts of tough vegetation. It also had extremely high rates of enamel defects, higher than any group yet studied, and oddly only affecting its back teeth. We don't yet know why these defects occurred, but when we do we will be better placed to understand who they were and what happened to them.

The best way to try and solve these and other mysteries is by studying as many other teeth as possible from a wide range of modern and fossil species. Luckily, thanks to the availability of fossilised teeth, that might be doable.
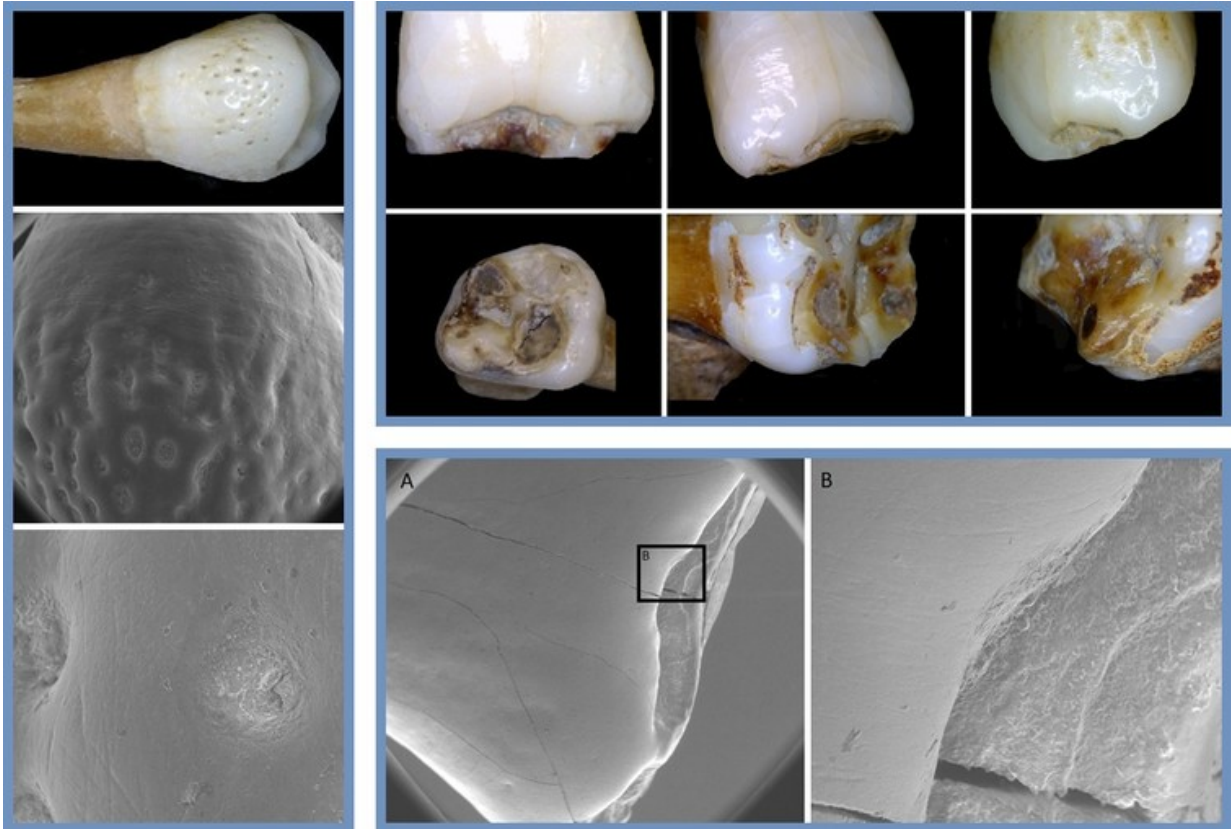
Enamel hypoplasia in Roman individual. Credit: Ian Towle, Author provided

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