Name: _____ Date: _____

The Mismatch at the Back of the Mouth

Reading level 14 · 1534 words

An alligator grows a small replacement tooth under each working one and swaps it out about once a year, up to roughly fifty times over its life. Sharks, geckos and most other animals with backbones replace their teeth again and again. Mammals are the main exception, and we are ordinary mammals in this respect. Twenty milk teeth are replaced once by thirty-two permanent ones, and after that there are no more. Biologists call this single swap diphyodonty, and they admit that little is known about what controls it. The result is a mouth run on a strict budget. Each adult tooth has to last for decades, and each has to fit into a jaw whose final size is not settled until the end of puberty. The wisdom teeth, the last four of the thirty-two, are where that budget most often fails.

Consider the schedule. The first permanent molars begin to form around birth and come through at about six, behind the baby teeth, without replacing any of them. The twelve teeth that an adult has beyond a child's twenty are, in fact, the molars, because the baby molars are followed by adult premolars. The third molars start late. Their crowns begin to harden at about seven to ten years old and are finished between twelve and sixteen, while their roots are not complete until somewhere between eighteen and twenty-five. Most come through between seventeen and twenty-one. If one has not appeared by twenty-five, oral surgeons generally assume it never will on its own. A fourteen-year-old's dental X-ray may therefore show four nearly finished crowns waiting in the bone, years before they are needed.

What actually lifts a tooth into the mouth is, remarkably, still not settled. Several explanations that once seemed obvious have been disproved: the growing root does not push the tooth up, nor does growth of the surrounding bone, nor the pressure of blood. The most widely held theory is that the ligaments holding the root provide the main push, perhaps pulling the tooth upward as their collagen fibers shrink and link together. The exit of a baby tooth is better understood. Cells called odontoclasts, a type of osteoclast (the cells that dissolve bone), break down the baby tooth's root, a normal process with the formal name of root resorption. The root then serves as a pathway for the permanent tooth beneath it, and the shedding is normally painless or nearly so, with a little bleeding at most.

A tooth is built once, and built before it is used. Dentin, the bulk of the tooth, always forms first, and enamel is laid over it. Enamel is the hardest substance in the human body, about 96 percent mineral. Once it is complete it contains no blood vessels, no nerves and no cells, which is why it cannot grow back. That does not mean it is helpless. All day long, acids made by mouth bacteria from sugar pull minerals out of enamel, while calcium and phosphate in saliva, with fluoride, put them back. An early white spot of decay can be stopped or even

reversed. A cavity cannot. The distinction is precise: lost minerals can be restored, but lost enamel is gone.

The wisdom tooth makes more sense once you look at our relatives. Gorillas, chimpanzees and monkeys all have third molars, and they rarely suffer for it, because they still eat large amounts of hard, tough food. A chimpanzee spends almost half of its day chewing, with far more force than we use. The fossil record shows how far we have moved from that. Australopithecus afarensis, the species of the famous skeleton called Lucy, lived roughly three to four million years ago and had jaws and teeth considerably larger and thicker than ours, with three big molars and thick enamel. Wear marks on fossil teeth suggest that such ancestors ate raw meat and plants that were much harder to chew than modern meals. For them, a third set of grinders was simply part of the equipment.

One clue to how the change began comes from a chewing laboratory. In a 2016 study at Harvard, Katie Zink and Daniel Lieberman had volunteers chew goat meat, a stand-in for the wild game early humans ate, raw and prepared in several ways, along with vegetables, while sensors measured the effort. From those trials the researchers calculated that with a diet one-third meat, the meat sliced and the vegetables pounded as stone tools allow, the effort per chew and the number of chews a day would both fall by almost 20 percent. Zink argued that meat and stone tools are what allowed jaws, teeth and chewing muscles to shrink later in human evolution. Cooking, farming and food storage later softened meals much further. Over millions of years, faces flattened, jaws shortened and teeth shrank, and the room left for the last molars shrank with them.

A jaw, however, is not simply inherited. It also grows in response to use, and this has been tested. In 2004 Lieberman and colleagues raised rock hyraxes on either raw and dried food or cooked food. Chewing the raw food produced bone strains in the skull up to twice as high at some sites, and the hyraxes raised on cooked food grew about 10 percent less in the lower and back parts of the face, where strain is greatest. The hyrax differences looked much like those between people who grow up on soft, processed food and people who do not. In 2011 Noreen von Cramon-Taubadel compared skulls from eleven populations around the world. The shape of the cranium tracked genetic relationships, as expected. The shape of the lower jaw tracked diet instead: hunter-gatherers had longer, narrower jaws with room for their teeth, while farmers had shorter, broader ones.

That second result is the elegant part. If lower jaws differed only because of ancestry, they should have followed the same family tree as the rest of the skull. They did not, which points to chewing during growth rather than inheritance alone. The archaeological record agrees. The oldest known impacted wisdom tooth belonged to a woman who lived in Europe between about 13,000 and 11,000 years before the common era, so the problem is not new. But impaction was relatively rare before modern times, and with the Industrial Revolution and its soft, processed foods it became about ten times more common. Julia Boughner, a Canadian

anthropologist who studies how teeth and jaws develop, adds a deadline. Jaw growth stops toward the end of puberty, so there are only about fifteen years in which chewing can influence it, and soft modern diets may leave jaws short of their potential.

One way to describe this is as a mismatch: a body built to one plan and grown in conditions the plan did not expect. The teeth arrive on their old schedule, the jaw grows to its modern length, and the last tooth in line finds no room. It may lodge sideways in the bone or break only partly through the gum, which is where trouble usually starts. Not every jaw has to cope with all four, however. About one person in four or five never forms at least one wisdom tooth, a much higher rate than for any other tooth. Scientists are not certain why, though inherited genes may play a role. Some have argued that missing wisdom teeth are an advantage for people with smaller jaws, but that is a hypothesis, not a demonstrated fact.

The practical question, whether to remove wisdom teeth before they cause trouble, is where the evidence is weakest. Impacted wisdom teeth lead to disease in roughly 12 percent of cases. The usual troubles are infected gums and decay; cysts are much rarer. A wisdom tooth that has come through fully, sits straight and stays healthy usually needs no treatment at all. For impacted teeth that cause no symptoms, there is not yet enough reliable evidence to say whether removing them is better than leaving them. Britain's National Institute for Health and Care Excellence advises against removing disease-free impacted wisdom teeth as a precaution. Practice may be shifting in the United States as well. A 2024 survey found that 53 percent of Americans had had wisdom teeth removed, compared with 26 percent of those aged eighteen to twenty-nine.

That gap may mean only that younger adults have had less time to develop problems, but it may also reflect dentists questioning routine extraction since the early 2000s. Several questions remain open. No one yet knows precisely what force raises a tooth into the mouth, what controls the single replacement in mammals while alligators get fifty, or whether giving children harder food would actually prevent impacted wisdom teeth. That last idea is plausible, given the hyraxes and the jaws, but hyraxes are not children, and a pattern in old skulls is not a proven cure. What is clear is that the wisdom tooth is not a design error. It is a tooth that forms on an ancient timetable, one set when jaws grew long and worked hard on tough food, and it arrives, as Aristotle observed long ago, at about the age of twenty, into a face that grew up on softer meals.

Questions

1. How are human teeth different from an alligator's?

A. Humans replace their teeth only once

B. Humans replace each tooth about fifty times

C. Alligators never replace teeth

2. Why can't lost enamel grow back?

A. It is covered by dentin

B. Once finished, it has no cells, nerves or blood vessels

C. Saliva dissolves it

3. Why is it important that lower-jaw shape tracked diet while the skull tracked genetic relationships?

A. It proves teeth are getting larger

B. It shows hyraxes are related to people

C. It suggests chewing during growth, not just ancestry, shapes the jaw

4. In the book, what does "mismatch" mean?

A. A body built for one set of conditions living in another

B. A missing tooth

C. A broken jaw

5. What does the book say about removing wisdom teeth that cause no problems?

A. It is always necessary

B. There is not enough reliable evidence to decide

C. It is against the law in Britain

6. Which idea does the book treat as plausible but not proven?

A. Chimpanzees have wisdom teeth

B. Enamel is mostly mineral

C. Harder food in childhood would prevent impacted wisdom teeth

Words to know

diphyodonty: two tooth sets
resorption: dissolving away
enamel: hard tooth coating
impacted: stuck in bone
mismatch: poor fit
cranium: skull case

Answer key: The Mismatch at the Back of the Mouth

1. A. Humans replace their teeth only once
2. B. Once finished, it has no cells, nerves or blood vessels
3. C. It suggests chewing during growth, not just ancestry, shapes the jaw
4. A. A body built for one set of conditions living in another
5. B. There is not enough reliable evidence to decide
6. C. Harder food in childhood would prevent impacted wisdom teeth