The 'poor tooth design' claim refuted

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It is often claimed that human teeth are poorly designed and this is why cracking, chipping, and fractures are common problems. When a tooth is cracked, it rarely can be appropriately repaired. Most often it must be ground down to the root or peg, and a new cap is glued on top called a crown, more precisely a new crown to replace the existing one (figure 1). As one evolutionist explained:

> "I have three crowns now and my wife has four, and we are still young adults. I was not hit by a baseball bat that caused this problem. In fact, I was chewing nuts when one cracked and the other time I have no idea when or why it happened. On a routine visit to the dentist I was informed that my 2nd molar was cracked and needed to be replaced. Evolution explains this poor design. The fact is, if some design works better than an alternative design, the better design will be selected by evolution. Natural selection preserves only the better design, not the perfect design. Adaptations result from changes caused by random mutations, and some of the results are positively bizarre. The poor design of teeth is one excellent example. If they were designed by an intelligent designer they would not crack or chip for no good reason, or experience the problems that I noted."[1]

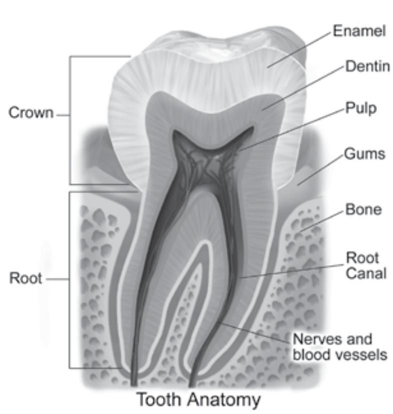

Figure 1. The top part of the tooth, or crown, is what is replaced in a dental crown replacement.

Clara Moskowitz, *Scientific American*'s senior editor, wrote that evolution is

> "… a weird, random, [and] not well-thought-out process … things happen randomly and are not necessarily the best way to do something if you were going to design it from scratch. It's just *a* way. Or it happened to be connected to some other gene. Things just happen."[2]

She then explains that some of those things that 'just happen' are certain human body parts, such as teeth. Teeth, she concludes, are not optimally designed, and in fact were not the result of any design but were rather the product of mutations selected by evolution. Consequently, evolutionists conclude, they work well enough to enable us to survive, but are not the best design possible compared to intelligently designing them from scratch as a creator would have done. As evolutionists explain:

> "Many organisms show features of appallingly bad design. This is because evolution via natural selection cannot construct traits from scratch; new traits must be modifications of previously existing traits. This is called historical constraint."[3]

The argument from poor design, also known as the dysteleological argument, is used against the existence of a creator God based on the idea that an omnipotent and omnibenevolent God would not create organisms with the alleged suboptimal designs seen in nature. Phrases such as 'poor design', 'suboptimal design', or 'unintelligent design' are often used to support this view.

The commonality of dental crowns

Single-implant crowns are now one of the most common prosthodontic procedures in the United States. Dentists, on average, place over two million crowns in patients annually.[4] A recent European study found over 30% of the adult population had a crown. A study of dental treatment of older people in New York City found that of the sample of 270 people over age 55, over 40% had crowns.[5] The number of crowns is not a good indication of the number of chipped and fractured teeth because crowns are done for many reasons, including repairing teeth that have had extensive fillings, due to the fact that crowns provide a more secure restoration compared to a regular filling. A dentist can fill a tooth only so many times. Each time the hole must be made larger, weakening the tooth framework. Consequently, after several fillings a crown, which is permanent, should be used. Cracking often occurs in old teeth which have amalgam restorations (figure 2) that expand on setting, creating micro fractures. Dentists now usually use composite materials with a bonding technique to avoid the cracking caused by amalgams.

Crowns surrounding the tooth act as a support, thereby helping to prevent fractures in the weak portions of the tooth. Crowns also improve the teeth aesthetics by replacing teeth that have extensive discoloration or silver/gold fillings. By providing support to maintain (especially posterior) teeth, crowns are also very important in stabilizing, restoring, and/or rehabilitating the patient's occlusion (bite).[6]

Crown repair failures

Looking at the data of crown failures helps put the failures of the original design in perspective. One study of the failure of teeth restorations

Figure 2. X-ray showing amalgam fillings (light parts)

found a significant number of failures during a 22-year evaluation. Of the 89 crowns placed in 428 adults by one dentist in Belgium from 1982 to 1999, 48% were judged well-functioning, 24% of the cases were not followed up due to the death of the patient, or movement to another city (or doctor) and other reasons, and 28% had failed. Failures were more often found in premolar teeth (34%) than in molars (27%). The median longevity of the dental work was 12.8 years for amalgam restorations, 7.8 years for resin restorations, and 14.6 years for crowns. Survival time was influenced by extension of restoration, patient age, pulpal vitality, and use of material and dentinal retentive pins.[7] Another long-term study, from 1986 to 1990, of posterior restorations of 61 patients and a total of 362 restorations, detected 110 failures (30%).[8]

New research on enamel design

Critical to tooth failure is the outer coating of teeth, called the enamel (figure 1). We know that the underlying tooth dentin is designed to support the enamel and new research supports the conclusion that enamel is specifically designed to resist cracks. An excellent review of the design traits of enamel are as follows:

> "Dental enamel is the most highly mineralized tissue in the human body. Its outstanding mechanical properties combine the extreme hardness and stiffness with exceptional resilience, which enables it to withstand hundreds of masticatory cycles with biting forces of up to 770 N [173 Pounds of Force], in the harsh environment of the oral cavity, which also undergoes extreme pH and temperature fluctuations within the human body. Despite the fact that it does not remodel or repair, it lasts decades without catastrophic failure."[9]

The (natural) tooth crowns in all tetrapods, including humans, are covered with enamel. Enamel is composed of carbonated hydroxyapatite packed at high density (95 wt%[10] in mature enamel), with only 1 wt% soft organic matrix and 4 wt% water. As is true of other biominerals, it must be space-filled, meaning few empty spaces exist in the tooth itself, in order to withstand the many forces that are part of chewing food. Chemically, enamel is a hierarchical nanocomposite material with a well-designed crystal organization, which is the key to its superior mechanical performance and the fact that it is both the hardest and most resilient human body tissue.[9]

Research has documented that teeth are ingeniously designed to prevent cracking. The building blocks of enamel are the enamel rods consisting of an array of aligned carbonated apatite crystals. The enamel design is morphologically aligned, parallel, ~50-nm-wide, microns-long nanocrystals bundled either into 5-µm-wide rods or their space-filling interrods. The orientation of the adjacent enamel nanocrystals is not parallel, but crossways, producing an important strengthening mechanism. If all crystals were parallel, a transverse crack would be able to propagate across the crystal interfaces, causing cracking failure. In contrast, because the crystals are *not* parallel a crack propagates primarily along the crystal *interfaces*, resulting in material toughening as a result of this crack deflection mechanism.

Within each rod, the crystals are not co-oriented with one another or with the long axis of the rod: the c-axes of adjacent nanocrystals are most frequently re-oriented by a 1° to 30° slope compared to the adjacent nanocrystals. Furthermore, this orientation within each rod gradually changes, producing an overall angle spread that varies between 30° and 90°. The best illustration of why this design is used is plywood, which consists of many thin layers of wood glued together. For each layer, the grain is oriented in a different direction to that of the layer below it, usually at a 90° angle compared to the previous one. This design is critical for plywood's strength and resistance to warping and splitting. Molecular dynamic simulations demonstrate that the observed re-orientations of adjacent enamel crystals cause crack deflection and, thus, resist cracking. This toughening mechanism contributes to the unique resilience of enamel, which for most healthy people lasts a lifetime under extreme physical and chemical challenges.[9]

Conversely, dietary mineral (especially fluoride) and vitamin deficiencies can disrupt proper development during enamel growth in childhood, causing teeth to be liable to crack and experience other problems.[11] Eating a diet *high* in fruits and vegetables, and *low* in acidic beverages (fruit juices, carbonated drinks, and alcohol), especially during tooth development in youth—as well as not smoking or chewing tobacco—has been found to contribute to sufficiently high-quality enamel development.[12] Bulimia and anorexia cause movement of stomach acid into the oral cavity, which destroys tooth structure. Chewing biltong, ice, beef jerky, or hard sweets can also damage the enamel. Bruxism (clenching or grinding the teeth), often triggered by stress, anxiety, or guilt causes abnormal tooth wear. Malalignment and missing teeth can cause one to chew in an odd way if one side of the mouth is favoured in chewing, and this may increase the risk of fracture. This is one reason dentists recommend replacing missing teeth with implants, dentures, or bridges.

Lastly, mutations can produce genetic diseases that cause tooth abnormalities, affecting the rate of development of primary and secondary teeth, causing them to become brittle. One of many examples is the disease *Dentinogenesis imperfecta*, which interferes with normal tooth development, affecting as many as 1 in 8,000 people.[13]

Summary

The cause of susceptibility to cracking, chipping, and tooth fractures is not poor design but most often poor diet leading to mineral and vitamin deficiencies in particular, especially during early tooth development. Recent research confirms that teeth are specifically designed to strongly resist cracking. As Elia Beniash, Ph.D. *et al.* concluded, the ingenious design of tooth enamel contributes to its being

> "… extraordinarily resilient, as it endures hundreds of mastication cycles per day, with hundreds of Newtons of biting force. This structure prevents catastrophic failure of enamel by deflecting cracks inside rods, and keeps it functional for our entire lifetime."[9]

Rather than blame the problem on design, the problem is often the poor health habits of the patient. The solution is clear: improve dental health by taking steps to remedy the health habits of those affected. The problem for design deniers is that each year scientists research the functions of various biological organisms, discovering and documenting ingenious design details and the constraints within which biological organisms must function. If humans do not know completely how something functions, how can a poor design charge be laid against God?

The poor-tooth-design claim is another argument that research has forced to be retracted.[14] The clear trajectory of scientific discovery supports the view that the world we live in is more complex than previously believed, not less. Science is going in the wrong direction by making the argument from poor design, because this argument is simply 'atheism of the gaps' that is forced by research to be progressively abandoned as science advances.

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