

Dental Modification: An Anthropological Perspective

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Abstract

Dental modification, also called dental art and dental mutilation, has occurred throughout history in human populations around the world. The altering of human dentition comes with serious risks that include pain, infection, and, in some cases, death. From the point of view of the anthropologist, modification of human dentition appears to be a maladaptive trait. Why would people choose to endure the pain of dental alteration, including dental in-lays, dental filing, tooth ablation, and gingival tattooing? The major focus of this paper is to determine why dental modification has occurred throughout history, and still occurs today, when there is a high rate of infection, high probability of tooth and alveolar bone loss, and much pain involved with the modification process. This library-based research project discusses the types of dental modification, the risks and techniques involved in modifying human dentition, possible reasons why modification for nonclinical reasons has occurred, and how future research can further advance knowledge in the field of dental anthropology. A clinical aspect detailing the pain during modification procedures is also included.

Dental Modification: An Anthropological Perspective

Introduction

Humans have modified their bodies for centuries via different means and for numerous reasons. Body modification can be seen today in some fashion in virtually all countries. Modification can include piercings, tattoos, paint or ground minerals smeared on the body in particular patterns, even hair can be cut or styled in such a way that it can be considered body modification. Paint and haircuts are nonpermanent means of modification, whereas piercings can be semipermanent—it is possible to take out certain piercings and have the holes seal themselves over time. Tattoos, however, are a more permanent form of body modification. Other forms of permanent modification include burning symbols and particular patterns into one's skin and also cutting one's skin so that scars will be left on the body in the shape of a symbol or intentional pattern. This technique is known as scarification. The focus of this paper, however, is intentional dental modification. There is, though, unintentional dental modification. Unintentional dental modification has occurred in the past and is still occurring today.

Unintentional modification can be seen when the teeth are used as tools, such as pliers, vises, and third hands. When the teeth are used as tools, they show grooves or notches on the occlusal surface that do not match the wear patterns of mastication (Scott and Turner 1988: 112). Another example of unintentional dental modification is the use of labrets, or lower lip rings, among Alaskan and Pacific Northwest natives. Labrets cause polished and worn labial and buccal tooth surfaces. Habitual use of pipes for smoking tobacco can also leave an unintentional wear pattern. When a pipe is clenched between the teeth, over time, equal abrasion of the upper and lower dentition may occur, causing an oval hole to be visible when a person is fully occluding his or her teeth (Scott and Turner 1988: 112). Using one's dentition for reasons other than mastication is an easy way to ensure that the teeth will wear more quickly than they would naturally under normal circumstances. Intentional dental

modification, though not as prevalent today as it was in the past, can still be seen in several areas of the world, most notably in African villages. According to the Human Relations Area Files, many different African cultures continue to participate in the practice of tooth ablation. These include the Amhara, Azande, Maasai, and Nuer people.

Modification of the body can be done for as many reasons as there are methods of modification. Perhaps a culture believes that in order for a god or goddess to respond to their sacrifices, rituals, and requests, they must have their bodies painted in a particular way. Modifying one's body may also be a means of achieving self-identity. Additionally, modifying the body may be something that an entire society performs, thus allowing a person to identify with his or her kinsmen and women. If one comes in contact with someone who has a different form of body modification, then it is obvious that one of the two people is an outsider and does not belong in that particular area. Body modification can also be seen as a means of attracting a person of the opposite sex, or it can be viewed as an intimidation device when confrontation arises. Oftentimes, body modification is a means of signifying the crossing-over from one stage of life to the next, such as the change from adolescence to adulthood once puberty is reached. From this list, it is fairly obvious that modification does not occur by accident and, even though modification is often painful, there is evidently a perceived benefit to enduring the pain and agreeing to participate in the modification process. Even if body modification does not have a ritual importance within a culture, peers can influence individuals to modify their bodies in one way or another.

Early Perceptions of Teeth

Prior to the days of agriculture and mass food production, caries in human dentition were rare. When a particular type of food can be harvested in a region, though, it can feed a larger population of people, allowing for further development of civilization. The downfall to this pattern is that diets

limited in variety and nutrition begin to harm the health of a person, along with his or her teeth. When the human race began experiencing toothaches due to bacterial infections and cavities, they needed to fabricate a reason for why the toothache was occurring. In early societies, magic was quite prevalent, and the idea of the toothworm was created. In virtually all societies, even when they had no contact with one another, the idea of the toothworm can be seen. It was originally believed that toothaches were caused by a toothworm that had either bored its way into the infected tooth or had spontaneously appeared. When severe pain was felt in the tooth, it was believed that the worm was angry and thrashing about, and when the pain had stopped, it was believed that the worm was in a state of rest (Ichord 2000: 6). The earliest record of the story of the toothworm was found in the royal library in Babylonia. The document found was written on a Sumerian clay tablet in cuneiform and dates back to 3000 BC. The poem found on the tablet read as:

After Anu (had created heaven)...

The earth had created the rivers,

The rivers had created the canals,

The canals had created the marsh,

The marsh had created the worm.

The worm went weeping, before Shamash,

His tears flowing before Ea:

“What wilt thou give me for my food?

What wilt thou give me for my sucking?”

“I shall give thee the ripe fig and the apricot.”

“Of what use are they to me, the ripe fig and the apricot?

Lift me up and among the teeth

And the gums cause me to dwell!

The blood of the tooth will I suck,

And of the gum will I gnaw the roots!” (Ichord 2000: 8)

Later, in addition to the presence of a worm in the tooth, it was also believed that the demons located within the body were displeased, causing a tooth to ache. Today, it is believed that the idea of the toothworm may have emerged when ancient people saw the pulp of the tooth. The pulp is comprised of the tooth’s nerves, and these nerves may have had a wormlike appearance (Ichord 2000: 8-9). Though caries were a problem in Babylon, no dental work such as filled teeth or dental prostheses have been found from this time period. The Assyrians and Persians also seem not to have performed dental work (Wynbrandt 1998: 9). There is, however, documentation that has been found showing that by 2250 BC, physicians would “smoke” toothworms out of cavities in the teeth by using nenbane seed kneaded into beeswax (Wynbrandt 1998: 8). This process, rather than ridding the tooth of the worm, most likely destroyed the nerve within the tooth. Once the nerve was dead, it would no longer cause pain to the individual, even though the bacteria would still be present.

Once scientific thought became prevalent, though, the concept of the toothworm was largely dispelled. Interestingly, though, a belief in a type of toothworm is still present in some African societies. Deciduous mandibular canines are removed in children prior to the complete eruption of the teeth into the oral cavity. The procedure of removing these teeth is considered a success if the toothworm has been completely removed. In this instance, the toothworm is the dental lamina, or the permanent mandibular canine prior to crown development (Graham 2000: 136). Oftentimes teeth, notably the mandibular canines or incisors, are removed in infants in African societies to fulfill a ritual. It is believed that the removal of these teeth prior to eruption will prevent illness, especially diarrhea. According to reports performed in Africa, many countries participate in the removal of canines and incisors. In certain villages in Tanzania, 60% of the people have intentionally removed their teeth, 16% in northern Uganda, 22% of the urban children in Sudan, 59% of the Ethiopian Jews, 70% among other

populations in Ethiopia, 87% of the Maasai in Kenya, and 100% of the infants younger than 18 months that had been admitted to a hospital in southern Sudan (Graham 2000: 135). Even though the concept of the toothworm exists only in Africa today, it is interesting that multiple countries that cover a wide area all believe that the removal of the toothworm helps ensure that an infant will be free of diarrhea. Additionally, the definition of the toothworm has changed, but the belief that this creature is literally present within the gums of a person and can cause actual harm is quite similar to the beliefs held in early human societies.

Forms of Dental Modification

The modification of human dentition is prevalent in many societies, both historically and in current contexts. Some refer to dental modification as dental mutilation, but this term has a negative connotation. Many societies view the dental modification that they perform as a prideful ritual that even enhances beauty. This modification helps them identify with their kin or village groups. Tooth alteration, among various cultural groups, may signify a rite of passage, the mourning of a loved one, group identity, or be a means of conforming to a concept of beauty (Ichord 2000: 84). The term dental mutilation also seems to come from an etic perspective of a culture rather than from an emic perspective; this is an important point to make from an anthropological point of view. If one goes into a study from an etic perspective, especially if the topic is not naturally-occurring in his or her culture, then this could be detrimental to the study as a whole. An anthropologist must look at topics, such as dental modification, from the perspective of a person living in a society that partakes in the ritual of dental modification. This being the case, the term dental mutilation will not be used in this research paper.

Dental modification can be seen in four forms: ablation, filing, drilling with inlays, and staining. Ablation, or dental evulsion, is the intentional removal of specific teeth for various reasons.

Dental evulsion is a cultural pattern that can be seen in areas in Africa today and areas in antiquity, including Italy (Becker 1999: 110-111). Filing is the literal filing away or chipping of specific teeth to create a particular pattern. These include the pointing of the ends of the teeth, filing down the canines to make them flat, or even cutting out portions of the tooth so that the tooth appears to be missing a chunk that is in a particular shape. See Figure 1 for examples of how dental filing can appear as an end-product. Drilling and inlaying teeth with carved materials such as precious metals or gemstones is the third way in which human dentition can be modified (Scott and Turner 1988: 113). The final way in which dental modification can occur is staining of the teeth and/or surrounding soft tissues. See Figure 2 for an example of stained gingival tissue. A key point in dental modification is that it mainly occurs on the labial surface of the anterior teeth, where it can most easily be seen by others. The anterior teeth include maxillary and mandibular incisors and canines. Obviously, dental modification has social implications, meaning that it was not done for medical reasons. Many African cultures today participate in rituals that involve both tooth ablation and filing.



Figure 1. Examples of Dental Modification
Top Row: Ablation of Incisors, Inverted V-Shape, V-
Bottom Row: T-Shape, Rectangular, Hour-Glass

Source: Reichart, Creutz, and Scheifele 2007: 51



Figure 2. Gingival tattoo
Source: Scully and Wilson 2006: 24

Dental Modification Around the World

Intentional dental modification is more prevalent throughout history than one might think. Though some modification may have been performed to relieve the pain of carious lesions and decay, there is evidence that many cases were, indeed, performed simply for aesthetic purposes. The first case in history in which altering the teeth for aesthetic reasons is seen comes from the seventh century B.C. by the Etruscans. Etruscan gold appliances were created out of flat gold bands that were used to hold a fake tooth and/or teeth in place. These appliances may have also been used to stabilize teeth that had been loosened by periodontal disease (Becker 1999: 103). Though the latter reason serves a clinical function, it is believed that these pieces mainly served aesthetic purposes. After measuring the elements that comprise these gold appliances and surveying the teeth that remain with the appliances, it seems that only Etruscan women were the wearers of these prosthetic devices. Additionally, it appears that cosmetic concerns served the reasoning behind their development. The fact that only women wore these appliances is interesting because the “Eastern” wire dental appliances of the later Phoenician tradition were worn strictly by men. These appliances were made out of gold or silver wire, and a total of six appliances remain (Becker 1999: 104). There are currently only nine surviving Etruscan gold appliances known, all of which were recovered from rich Etruscan tombs. These pieces were all

recovered in the area of ancient Tarquinia in the Italian region Lazio (Becker 1999: 104-105). Due to the fact that these appliances were only recovered from the tombs of the wealthy suggests that they were considered symbols of high status. According to Woodforde (1968: 11), these Etruscan appliances were considered a luxury and a refinement that were only accessible to those of wealth and power. Additionally, they were much admired.

Though these gold bands may have supported unstable teeth within the oral cavity, it seems that they may have actually been created purely for decorative reasons (Becker 1999: 107). Many of these appliances now have been taken out of context and do not remain within skeletal remains, though it has been determined that they fit around anterior maxillary teeth rather than either posterior dentition or mandibular teeth. In Etruscan society, adults generally lost their molars to decay after the age of forty, and incisors were rarely lost except in people of very old age—older than seventy or seventy-five years (Becker 1999: 110). This evidence does not match the purpose of the Etruscan appliances.

Three gold appliances described by Becker (1999) all appear to have been worn by females around the maxillary anterior dentition. Unfortunately, all three of these appliances have been lost, but documents describing them, along with drawings, are still in existence. Barrett I (ca. 600 B.C. from Lake Bolsena at Bisenzio) is an appliance that fit around three maxillary anterior teeth, Barrett II (ca. 500-480 B.C. from Lake Bolsena at Bisenzio) fit around four, maybe five, maxillary teeth, and the Van Marter appliance (ca. 600 B.C. from the Lake of Valseno near Rome) was made to fit maxillary teeth. What is interesting about the Van Marter appliance is that it contains a false central incisor and two gold rings, one on either side of the false tooth, that would encircle the remaining central and adjacent lateral incisors so that the false tooth could be stabilized in the mouth (Becker 1999: 105-109). This appliance is quite similar to the Copenhagen appliance, which was found in Orvieto in Umbria, Italy. It is currently housed in the Danish National Museum and is depicted below in Figure 3. Based on archaeological evidence of natural tooth decay and the appearance of Etruscan dental appliances, it has

been deducted that high-status Etruscan women deliberately removed a maxillary central incisor so that they could be fitted with a gold band appliance containing a replacement tooth (Becker 1999: 110). Some of these appliances even contained gold bands that extended above the gum line so that irritation could be prevented (Woodforde 1968: 11). Figure 4 shows an example of the type of appliance that contained both a false tooth and was made of an exceptionally thick gold band. The decline in use of these dental appliances matches the decline in Etruscan cities, writing, and culture as it became replaced by the growing and dominating Roman Empire (Becker 1999: 104, 111). These Etruscan pieces, however, are important in displaying the earliest use of aesthetic dental modification.

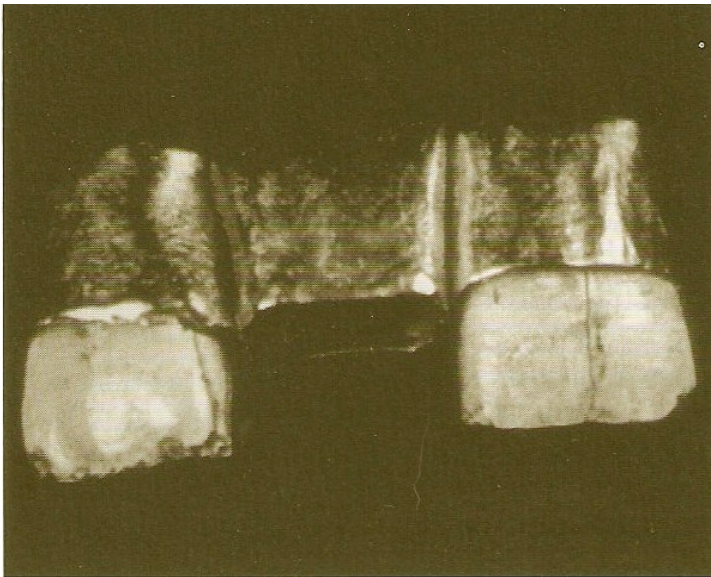


Figure 3. The Copenhagen appliance that is similar to the drawings found of the Van Marter appliance
Source: Becker 1999: 110

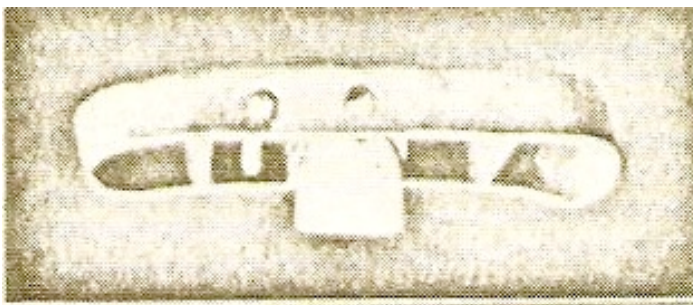


Figure 4. Etruscan appliance with false tooth
Source: Woodforde 1968: 11

In Ancient Rome, extraction of decayed teeth was common, and these extractions were performed with forceps and bare fingers. They also invented gold shell crowns for loose teeth and made artificial replacement teeth from bone, boxwood, and ivory. This, however, was only performed in the wealthy citizens (Wynbrandt 1998: 20-21). Dental decay and its prevention were not fully understood during this time period, but tooth powder was used and recommended to help brighten the teeth rather than simply to clean the teeth (Becker 1989: 36). This suggests that the appearance of teeth was of importance during this time period, even if the gold crowns and replacement teeth were reserved only for the wealthy.

Later instances of intentional dental modification can be seen in Marco Polo's book *Travels*, published in 1295. In this book, he explained that in Karbandan in southern China, "both the men and the women of this province have the custom of covering their teeth with thin plates of gold, which are fitted with great nicety to the shape of the teeth, and remain on them continuously" (Wynbrandt 1998: 15). Again, this is an instance where dental modification occurred, not for clinical reasons, but rather for cosmetic reasons. It was considered beautiful.

Some of the most interesting and unique intentional dental modification can be seen in the remains of skeletons from pre-Columbian societies. The first form of dental modification in ancient Mesoamerica was dental filing. This was a painful process in which a designated person would file unwanted portions of the tooth. Stone tools were the preferred method for filing away portions of teeth. In fact, obsidian tools can easily alter the natural shape of the tooth (Benedix 1998: 35-36). See Figure 5. A person must have much practice and skill to successfully file dentition without causing permanent damage that will end in the loss of the tooth being filed. One reason why dental filing occurred could have been to honor the Mesoamerican solar deity who was traditionally depicted with filed teeth (Wynbrandt 1998: 77). That may have been the most meaningful way of showing respect and admiration.

Later, the technique of drilling and placing inlays in the teeth was developed. This process, like filing, is quite difficult. First, a small hole must be drilled in the labial surface of the tooth, without piercing the pulp chamber. This hole was created via bow drill with a hollow tubular bit, oftentimes made of jade, copper, or bird bone. Powdered quartz or fine sand was used as an abrasive. Then, the hole had to be plugged with a mineral of the same size as the hole that was created. Ancient Mesoamericans used iron pyrite, hematite, jadeite, jade, turquoise, quartz, serpentine, rock crystal, Mother-of-Pearl, and cinnabar in their inlays (Benedix 1998: 36). Most studies, though, suggest that iron pyrite and jade were most common (Smith 1996). See Figures 6, 7, and 8.



Figure 5. Fresco showing tooth filing
Source: Romero 1958

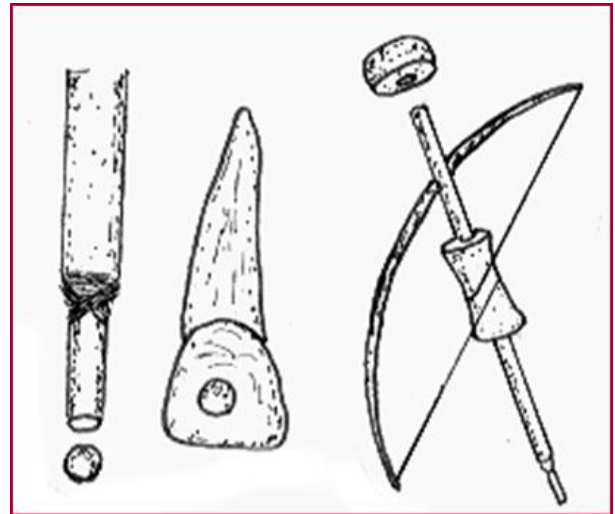


Figure 6. Bow drill and tooth upon completion of inlay
Source: C.J. 1999

Figure 7. Image of how a bow drill was used on patients in Mesoamerican societies.

Source: Ichord 2000: 29



Figure 8. Skull with inlays on labial surface of anterior maxillary dentition

Source: Romero 1958

Other parts of the world performed dental modification, too. In ancient Japan, women used to dye their teeth black with tannin powder and a ferrous acetate solution. This was considered a sign of fashion and marital status. This practice was quite popular and even lasted into the early twentieth

century. Interestingly, coloring the teeth was also beneficial. It was unknown at the time, but this technique protected the teeth from bacterial colonization (Ichord 2000: 84). Teeth are obviously a focal point in the determination of fashion and wealth across many cultures.

In England during the late 1600's and early 1700's, artificial teeth became fashionable for the wealthy. They were considered both ornamental and sophisticated. These teeth and the bases upon which they were mounted were made out of ivory from either hippopotami or walruses. This ivory piece was then anchored in the mouth with a thread of metal or silk by tying it to the remaining natural dentition (Woodforde 1968: 24). Though these pieces did not appear natural and they were uncomfortable, they were endured because it was more embarrassing to be seen with missing teeth.

This is a similar scenario to that seen in eighteenth century Paris, France. At this time, false teeth were preferred over bare gums even though the prosthetic appliances were extremely uncomfortable. Only the wealthy could afford to own false teeth, and personal appearance was of paramount importance. Gaps in the teeth were considered disfiguring (Woodforde 1968: 46). This thought process, however, does not differ greatly from the views of people in the United States today. The main focus of orthodontics is the straightening of the dentition, and general dentists make dentures for people who have lost their natural teeth.

In the more recent past, Australian tribes used to perform tooth ablations, where they would purposefully remove particular teeth as either a rite of passage or as a sign of mourning. (Ichord 2000: 85). The Aranda in Australia used to remove teeth in young boys as part of an initiation, and the mother of the boy would choose a young gum tree and insert the tooth into the bark. When a man died in that society, the tree in which his tooth had been inserted would be stripped of its bark (Roheim 1945: 4). Some South American Indians of the Amazon Valley continue the practice of filing their maxillary central incisors to points as a means of imitating the piranha that live in the river and are greatly feared. Consequently, sharpened teeth are also considered a mark of beauty (Ichord 2000: 85).

Both beauty and rites of passage are often cited as reasons behind intentional dental modification.

Modern-Day Dental Modification

Rites of passage are often cited as reasons why dental modification occurs. This is likely due to the fact that it is both a permanent change and traumatic experience. Such an experience could easily signify a climactic change in one's life.

According to the Maasai of Tanzania, who participate in a form of dental modification, there is a medical reason as to why they perform tooth ablations. The removal of the mandibular central incisors helps ensure that a person can be fed in case he or she, at some point, suffers from tetanus, which can result in lockjaw. The Damara people of South Africa claim it is necessary to remove one's maxillary anterior teeth in order to properly speak their language—a lisp must be induced. Research also shows that dental filing and tooth ablation, as stated earlier, may be a result of initiation rites from childhood to adulthood. Among the Igbo in Nigeria, women are not allowed to bear children before having their teeth filed (Goose 1963: 91). In several different societies, dental modification does not occur until a male or female reaches puberty, and most cases of modification show that it occurs in young adults. There are, however, instances in which tooth ablation is found in infants. The ablation of deciduous canines can be seen among the Bakiga, Acholi, Batoros, and Bugisus of Uganda and the Haya of Tanzania. Reasons for ablation are that these teeth are associated with disease, so they are removed in order to maintain health (Benedix 1998: 49). Oftentimes, parents will take their children to traditional healers to have the canines removed at the first sign of an infant or child vomiting or having diarrhea. This operation is also performed in Nigeria, and it is called ebino, or “false tooth”. The deciduous canine tooth buds are extracted when gingival swellings first appear during tooth eruption. In Somalia this same practice is called Ilko dacowo (Scully and Wilson 2006: 23). The tooth buds are often removed, which can cause problems with spacing in the oral cavity. Permanent teeth that come in

later may not have the necessary room needed to fit well in the mouth. Other problems include the fact that the removal of the tooth bud may damage the permanent canine, causing the canine to never erupt (Graham 2000: 135). Obviously, there are serious threats to the oral health of patients undergoing such procedures.

Another form of dental modification is dental and soft tissue staining. In Peru, Ecuador, Vietnam, Laos, Thailand, the Philippines, and Africa tooth staining occurs among the indigenous people. Different types of flowers are often used in these staining techniques. In Nigeria, some people stain their teeth with flowers of *Solanum incanum*, a relative of the eggplant, or *Nicotiana tabacum*, an herb that contains nicotine (Scully and Wilson 2006: 23). This is a form of semipermanent dental modification. Tattooing of the soft tissues in the mouth is another form of dental modification. Though this is not necessarily making a change in the dentition, it is still altering the oral cavity. Lip tattooing can mainly be seen in North Africa. In Nigeria, some people tattoo their lips or gingiva prior to marriage. This is performed without anesthesia with thorns of *Balanites aegyptiaca*, a tree native in much of Africa. The tattooing agent/ink is a mixture of charcoal and the seeds of *Acacia nilotica* var. *tomentosa*. Some female Muslims in North Africa and the Middle East undergo maxillary blue-black gingival tattooing (Scully and Wilson 2006: 24). Refer back to Figure 2.

The above examples of modern dental modification are from non-Western societies. There are, however, examples of dental modification occurring in the United States and Europe. One example of Western dental modification is the use of orthodontics. Palatal expanders are used to create more room for erupting teeth, braces are used to help straighten teeth, and dental retainers are used to ensure teeth remain in the same positions created by the braces. If the teeth are considered too small, too weak, or are simply poorly shaped, porcelain veneers can be placed over the remaining dentition. Additionally, many people in the United States try to modify their dentition by applying abrasives that help whiten teeth, bringing them back to their “natural” color (Scott and Turner 1997: xv). Just like in areas that

view dental modification in the form of filing, inlays, and ablation as being attractive in the opposite sex, teeth play a prominent role in determining sexual attractiveness in the United States. Though applying a whitening solution to one's teeth may not seem as extreme and painful as physically changing the shape of the dentition, these solutions do cause the enamel to become more porous, allowing for increased sensitivity to foods and drinks of extreme temperatures. If one whitened his or her teeth every day, the enamel could become increasingly more sensitive. Why, then, do people choose to modify their teeth even though there is a risk of pain? According to Scott and Turner (1997), an informal poll among a college population showed that the appearance of teeth was key in determining the attractiveness of a person of the opposite sex. This poll showed that 94% of the students asked "felt teeth were an important element of physical attraction" (in Benedix 1998: 40). There are, however, more unusual instances of dental modification in the United States mainly involving African-Americans. There is a fad among African-Americans in which ornamental gold crowns are placed on anterior teeth. See Figure 9. According to Scully and Wilson (2006: 23), these gold crowns that are placed on the teeth purely for aesthetic reasons are termed tooth jewelry. Some of these crowns even have cutout designs, or windows, that are popular in various cultures throughout America (Ichord 2000:84-85). This custom of capping the teeth has become so popular that there are even instances where if a person is missing his or her teeth, he or she will have decorative gold crowns placed onto his or her dentures. This act of capping one's teeth with gold crowns is a sign of pride and wealth among African-Americans (Benedix 1998: 48). Only those who are well-off can afford the luxury of having gold teeth. This is a signal to individuals of the opposite sex that this person is someone who should be considered when selecting a sexual partner.

Even more recently, the fad among the African-American community that signifies a high social status is the dental grill. A grill is a dental device that is made of gold, platinum, or other metal that is often encrusted with jewels that can be inserted on top of the maxillary anterior dentition (Hollowell

and Childers 2007: 320). This device can easily be removed so that, during the day, a person can go to work and operate in a professional environment without wearing the grill. Then, at night, he or she can insert the grill over his or her anterior teeth when he or she wants to be viewed in a social context.

Fewer people can afford grills than gold caps, so these people are most likely viewed as being ranked higher in the social order than those who only possess gold caps. While different forms of oral jewelry have become social status symbols within the Hip-Hop industry, and these pieces are crafted by jewelers and placed by dentists, lower socioeconomic status people have begun wearing grills of lower quality (Jeger et al 2009: 615). Grills are quite expensive, since high-end grills contain precious metal and jewels, so most people cannot own real, quality grills. Additionally, grills are costly because of the fact that they allow food and debris to become trapped between the teeth and the grill. This is a feeding ground for bacteria, which then allows for accelerated decay on the covered teeth (ADA 2006: 1192). A few examples of celebrities in the United States who have oral jewelry are Ke\$ha, a singer who had a diamond inlayed on her right maxillary canine; Kanye West, a rapper who had diamonds permanently cemented to his mandibular anterior dentition; and Nelly and Li'l Wayne, both rappers who regularly wears grills over both their maxillary and mandibular anterior dentition. See figure 10 below.



Figure 9. Gold crown tooth jewelry
Source: Scully and Wilson 2006:23



Figure 10. Ke\$ha with diamond inlay
http://nymag.com/daily/fashion/2010/02/janet_jackson_causes_a_kerfuff.html
Kanye West with diamond-encrusted mandibular teeth
<http://www.hollywoodgrind.com/kanye-west-replaced-his-teeth-with-diamonds/>



Figure 10. Nelly and Li'l Wayne with grills

Source:
<http://www.frigginrandom.com/screw-white-teeth-i-want-diamonds-7-photos/>

Problems of Dental Modification—The Structure of the Tooth

The human dentition is resilient in many respects. Teeth can withstand fairly harsh diets, they can withstand years of unintentional grinding, and they can be bumped while playing sports or exercising without immediately cracking and falling out of their sockets. The tooth, however, only has a set amount of enamel and dentine that it can offer as protection before the pulp chamber, which contains the nerves of the tooth, is compromised, becoming infected. The pulp chamber contains both blood vessels and nerves. These serve as the life support for the dentition for the duration of a person's life. Pulp nerves provide a protective mechanism for the tooth, meaning that when one feels pain in a tooth, this is a signal that an infection has occurred and needs to be eliminated promptly. The pulp includes several other functions as well: inductive, it initiates tooth formation; formative, it forms the dentine that protects the pulp; protective, it responds to heat, cold, pressure, and operative cutting procedures; nutritive, it carries oxygen and nutrition to the developing and functioning tooth; and reparative, it responds to dental caries and forms reparative dentine (Avery and Chiego 2006: 133).

Penetration of the pulp is a serious issue. If it does occur, the likelihood of infection is extremely high. See Figure 11 for a schematic of the tooth. When dental modification is occurring, mainly during filing and placing inlays, if the pulp chamber is pierced, it is likely that the tooth will die and have to be removed. Thus, it is key that the person performing the modification be skilled and knowledgeable of the inner-workings of the tooth and be able to gauge when the procedure is nearing the pulp chamber.

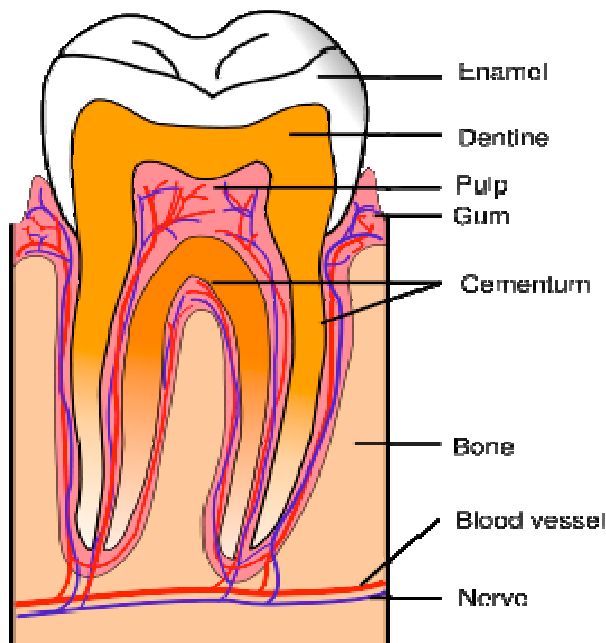


Figure 11. Diagram of tooth showing the location of the pulp underneath the layers of enamel and dentine, respectively

Source: Front Range Endodontics

http://www.frontrangeendo.com/root_canal_treatment.php

Clinical Aspect

The oral cavity is an area where bacteria can easily be introduced, reproducing at alarming rates. Additionally, the teeth can be quite sensitive when worked upon without local anesthetic. According to Dr. Susan Orwick-Barnes, a practicing dentist in Knoxville, Tennessee, when a person has a tooth filled without the aid of an anesthetic, the dentine tubules are stimulated and the patient experiences a 5-6 on the pain scale (personal communication, 2010). If the pain experienced during a filling in the dentine has such a high classification, exposure of the pulp chamber should be almost

unbearable. Accordingly, since the pulp chamber contains both nerve bundles and nerve endings, the pain experienced during pulpal exposure is more intense and falls between 9 and 10 on the pain scale. It is important to note, however, that each person's perception of pain is different, along with his or her response to anesthetics, if available. When a person grows older, however, the pulp chamber shrinks, becoming less sensitive. Thus, younger patients experience more pain when their teeth are worked upon due to the presence of a larger, more sensitive pulp chamber (Orwick-Barnes, personal communication, 2010). Since much of the dental modification discussed in earlier sections would have occurred without local anesthetic, it seems that intentional modification should be endured at a later age when the teeth become less sensitive. This, however, is generally not the case. Most examples of dental modification involve patients who are either adolescents or young adults, and, many times, the procedures help signify the crossing-over event that occurs when one becomes an adult. This being the case, modification of one's dentition is quite costly to the patient since such intense pain is endured both during and after the procedure while in recovery.

Though inlays of precious stones are not often seen in the dentition of patients in the United States, soft tissue piercings are seen and pose a threat to the teeth. Tongue piercings often clank against the teeth due to the normal movement of the tongue, causing the teeth to either crack or even chip and break. Additionally, people with tongue rings often find themselves absent-mindedly playing with their piercing, which can cause accidents. Dr. Orwick-Barnes witnessed a case where a patient with a tongue piercing had been playing with the piercing between his teeth and was startled by another individual entering the room. He jumped, and the piercing tore his tongue, causing him to undergo reparative surgery (personal communication, 2010). Tongue piercings are not the only detrimental form of soft tissue piercings. Another type is the labret, a piercing located beneath the lower lip. Labrets cause gingival tissue recession on the facial surface of the anterior mandibular dentition that can only be remedied by removing the piercing and placing a gum graft over the afflicted area. The

third form of soft tissue modification is cheek piercing, a piercing placed in the facial tissue that pierces straight through the skin of the face and into the oral cavity. These piercings can be placed low on the cheeks where dimples are naturally located or higher toward the cheekbones. Cheek piercings have the potential of damaging the buccal gingival tissue of both the premolars and molars. Additionally, the cheek piercings that are placed higher in the cheeks run the risk of damaging the parotid gland in the cheek or the parotid duct (Orwick-Barnes, personal communication, 2010). All three types of piercings can cause infections due to the fact that they are opening up an area in the skin that has a direct route into the oral cavity. See figure 12 for examples of soft tissue piercings.



Figure 12. Images of a tongue piercing, labret piercing, and cheek piercing

Sources:

Tongue piercing- Weisman 2010

Labret piercing- Ink Factory Tattoo 2010

Cheek piercing- www.justpiercings.com

The microorganism most commonly found in the oral cavity, causing caries in the dentition, is *Streptococcus mutans*, a Gram positive, facultative anaerobe. This bacteria produces acids that allow it to adhere to the teeth (and cause cavities to be created) so that they can feed on the carbohydrates found on the teeth (Dentist.net 1999). As periodontal disease progresses, though, the bacterial community changes. If untreated, teeth will often be lost. When dental modification occurs, such as inlays of precious metal or stone, and alveolar bone resorption is seen (See Figure 13), the roots of teeth will often loosen, causing eventual loss of the tooth. Though people with this type of modification can still eat, if tooth loss occurs these individuals may have to make dietary changes.

Dental Modification Mishaps

In most cases in which the pulp is compromised, the tooth inevitably dies due to bacterial infection. If the infection is not eradicated from the body, not only will the infected tooth abscess, or fall out, but the surrounding teeth may fall out, as well. In extreme, though not uncommon, cases, alveolar bone resorbs due to infection resulting directly from dental modification. This exposes tooth roots, which causes these teeth to inevitably fall out. See Figure 13. In the case of alveolar bone resorption, researchers can determine that the resorption is due to the dental inlays rather than periodontal disease because they are able to analyze the age of the bone upon the person's death. In these cases, the individual was quite young and should not have been experiencing periodontal disease, so one can conclude that the resorption was related to a botched dental modification procedure (Logan lecture 2010). This is unfortunate because when a young skeleton is discovered with alveolar bone loss, this means the dental procedure most likely shortened his or her life due to a spreading infection that was extremely painful and intolerable. Even if a dental operation was successful, though, one could not masticate properly for several days after completion of the procedure, and, in some cases, the pain never dissipated and the individual could never chew food as easily and in the same manner that

was possible prior to the dental operation.



Figure 13. Example of alveolar bone loss due to mineral inlays; evident tooth root exposure.

Source: Logan slide collection

Some skeletons in the archaeological record show evidence of incomplete inlays. According to Rubin de la Borbolla (1940), this would happen if the procedure had to be discontinued due to the pain being too intense or the individual undergoing the procedure died prior to its completion (in Benedix 1998: 25). Death may have resulted fairly soon after the completion of a modification procedure because there is evidence that there was a high risk for bacterial encephalitis among these individuals (Logan and Qirko 1996: 618). Since death is a possible outcome of intentional dental modification, it should be considered a high-risk procedure. Due to the risky nature of intentional dental modification, it seems as though this should be considered a maladaptive trait. In fact, Davies (1972) found that “there were more caries in filed teeth than in unfilled teeth” when analyzing specimens from Borneo (in Benedix 1998: 26). Even though dental modification involves serious risks, it still occurs today, to an extent, all over the world. Why would one risk the possibility of developing an infection that could lead to tooth loss and possibly bone resorption? What benefits could outweigh these evident risks and the excruciating pain that will be endured during the modification procedure?

Understanding the Procedure

When one considers the dental modification that occurs in the United States, the procedures do not seem to be high in risk. Whitening the enamel and placing a removable gold plate over the anterior dentition are not exceptionally detrimental to one's health. When the process of how dental filing and placing mineral inlays with a bow drill are considered, though, the risks seem quite clear. It is important, however, to understand the procedure and the pain that is endured by those who choose to go through with a modification procedure. During these procedures, oftentimes, especially in the past, no anesthetics were given to the "patient" to help endure the pain.

According to Benedix (1998: 36-37), researchers, including Mata (1994 and 1996) and Woods (1996) have begun replicative studies on dental inlaying in Guatemala on donated teeth. The techniques used in these studies include replica bow and pump drills with hollow bird bone and copper bits. The labial surface of each tooth is coated with bee's wax, a small area is scratched to expose the enamel, and a drop of acid derived from plant extracts is used to start an indentation on the enamel. These steps are critical to the process because the indentation made by the acid acts as a guide for the drill. Studies such as this are critical in furthering anthropological understandings of the past. This study, in particular, can be viewed as beneficial because it helps the academic community understand how such procedures could take place, and it shows exactly how difficult these procedures were to perform. It also helps give the academic community appreciation for the skill of the person performing the operation.

Rather than viewing the traditional healer in these societies as a person who performs dental mutilation (etic perspective), anthropologists may be able to gain an appreciation behind the rituals of dental modification (emic perspective). The healer or practitioner of dental modification had to have a feel for the depth he or she could feasibly drill before penetrating the pulp chamber, and he or she had to be time-efficient when performing these procedures because there was, undoubtedly, much pain

endured by the “patient” undergoing the modification procedure. It may not have been possible, however, to be fast when filing and chipping away portions of a tooth, especially if multiple teeth were involved in the procedure. According to Dr. Wil Lala, a practicing dentist in the United States, who has performed dental filing on freshly-extracted teeth with obsidian blades, this practice would take a large amount of time and many obsidian blades would be needed to perform a full procedure. According to Lala's experiments, the blades of obsidian tools dull both quickly and easily (Smith 1996). In addition to being both patient and skilled at his or her profession, the practitioner of dental modification had to have been quite competent in the field because dental modification comes with a serious risk of loss of life to the tooth and perhaps even the person/patient. Proficient techniques and skilled craftspeople, however, had to have existed because dental modification has lasted for thousands of years and is occurring today.

Unlike the developed nations of the world today, Etruscans, Romans, ancient Mesoamericans, and even Africans today, did not and do not have the anesthetics and medication that dentists have access to when performing modern dental procedures. There is, however, some evidence that medicinal plants were used to help relieve pain during both dental filings and drillings for mineral and stone inlays. In fact, some plants found in the Belizean forests have numbing effects that are as powerful as Novocaine (Smith 1996). Further studies on medicinal plants could help show how much pain could have been alleviated during the modification process. Additionally, societies in Africa that still perform dental filing may convey some information on plants that can be used to alleviate pain.

Reasons for and Benefits of Dental Modification

To anthropologists researching this topic, dental modification may be viewed as a maladaptive trait. A maladaptive trait is any trait or behavior that interferes with an individual's ability to pass along his or her genes to the next generation (Logan and Qirko 1996: 616). Since there are instances of

young people dying from intentional dental modification, which may have occurred before they reproduced, then modification is a maladaptive trait. If intentional dental modification can be considered a maladaptive trait, why then was it so widespread and still continues to occur? What are the possible benefits of operating on one's dentition? Every culture has its own views on how teeth should appear, so perhaps the benefit of modification is that it enhances beauty and attracts the opposite sex (Benedix 1998: 40). If altered dentition is considered attractive to the opposite sex, then the concept of dental art can be viewed as beneficial to a person, despite the potential health risks it involves. To the people receiving the oral procedures, they must believe that the benefits he or she will receive after the procedure has been completed will outweigh the risks involved. If this were not the case, modification would have ended fairly quickly. Obviously, those who underwent intentional dental modification in the past experienced some sort of reproductive advantage because passing along one's genes to the next generation, according to Darwin's theory of evolution, is every individual's main goal in life.

In the case of intentional dental modification, individuals with modified dentition who lived in a stratified society may have had access to more potential mates than those who did not have a modified dentition (Benedix 1998: 43). According to burial sites, the more modified a person's dentition, the higher status he or she experienced in life. This knowledge is based on burial goods found with bodily remains and other personal adornment. If this were the case, then it would definitely be beneficial to modify one's dentition, no matter what risks were involved. The belief that modification enhances personal status can still be studied today by going to African societies that participate in modification via filing or gingival tattooing. Though the types of modification have changed throughout the course of human history, it is likely that the reasons behind dental modification have remained relatively unchanged.

Cultural Conformity

Though there is a great amount of pain and risk of infection to the oral cavity involved in the modification of human dentition, there may still be a likely reason as to why these practices occurred and are still occurring today. Humans tend to conform to the ideas and practices of the majority in any society. One reason as to why this may occur is because the majority, after all, is reproductively successful (Logan and Qirko 1996: 622). Another point made by Logan and Qirko (1996: 625) is that since there is such a large number of different societies that practiced dental modification throughout history, this tradition may be an example of cultural conformity. Cultural conformity carries both social and biological rewards. Thus, if the majority of the members in a given society participated in intentional dental modification and experienced reproductive success, it follows that the tradition of dental modification would be continued in future generations. For the future generations in any particular society, there is a shared, visible trait among the reproductively fit of previous generations, so naturally they would choose to conform to the societal view that dental modification is beneficial.

Though most people in societies that participate in practices involving dental modification will not say that the reason they modify their teeth is because they are conforming to the norms of the majority, they may give other, more personal reasons as to why modification is so prevalent in his or her culture. Cultural groups may perform intentional dental modification in order to maintain tribal identity and group cohesion. If a person had his or her teeth altered in a particular fashion, it would be easy to determine whether or not he or she belonged to a particular group or was a trespasser (Benedix 1998: 49). According to Ichord (2000: 84), ancient Mayan societies placed inlays of jade and turquoise in the incisor teeth for both ritual and religious purposes. Some cultures believed that modifying one's dentition would protect one against death, so these procedures were continued as rituals (Bremner 1958: 15). Ancient Mesoamericans may have modified their teeth in order to appear more warlike while encountering enemies. Some African cultures were documented as filing their lateral and central

incisors into points so that they could simulate tigers and appear more ferocious (Bremner 1958: 15).

Dental modification could feasibly be used as a means of intimidation, especially if people with modified dentition came in contact with people who had never witnessed this practice in the past.

Costly Signaling Theory

A theory not given much attention when discussing intentional dental modification is costly signaling theory. This theory states that in a culture, individuals must employ signals (usually costly ones) that can be seen by others and that help ensure that one secures rewards, usually a mate. Costly signaling theory proposes that expensive and seemingly arbitrary or “wasteful” behavioral or morphological traits are designed to convey information benefiting both the signaler and the observers in the situation. Costly signals must be costly enough so that they cannot be easily counterfeited, allowing lower quality individuals to have the same benefits of the higher quality individuals. For this theory to work, the signals must be honest so that the receiver of the signals is not tricked and the signaler is not misrepresented (Archetti 2010: 201). These signals reveal important characteristics about the signaler that are important to the observer—elements that will affect their payoffs from social interaction with the signaler. In costly signaling theory, two conditions must be met. These conditions are that 1. both signalers and receivers must benefit from sharing information, and 2. signals must impose a cost on the signaler that is linked to the quality being advertised (Smith and Bird in Gintis et al 2005: 116). This theory is important for potential mates to employ because costly signals reveal the quality of the sender while allowing the receiver to choose the best possible option (Archetti 2010: 201). Costly signaling theory may be used when analyzing intentional dental modification because costly acts, such as purchasing gold caps and grills, show that the signaler has access to resources, thus helping ensure mate selection. This model can also be used to assess the riskier forms of dental modification. Since certain forms of dental modification have been and are used to identify rankings in

social status, a person's dentition may signal to potential mates that he or she has high-ranking and will be a good person with whom to combine genes. Both men and women who have high social status have access to richer resources than those who are of a lower social status. This concept is easily seen today when comparing the socioeconomic statuses of different people. According to Smith and Bird (2005), in order for a behavior to count as a costly signal, it must adhere to four conditions:

1. beneficial to others, 2. observable by others, 3. costly to the signaler in ways that cannot be reciprocated, and 4. associated with some strength or fitness of the signaler. All of these conditions, except for maybe the first, are met when analyzing intentional dental modification. Intentional dental modification can be beneficial to others if it is viewed as a means of allowing a person, especially a future mate, know that the signaler holds some power. It could also be beneficial if the modification signifies beauty within a particular culture. The second condition is easily met—everywhere that the signaling person travels, people can see his or her altered dentition. The third condition, much like the second condition, is easily met. The signaler can never “undo” the dental alteration he or she has endured. Finally, the fourth condition is also met in this scenario. Evidently, the person who underwent dental modification can be considered to have a high pain threshold because he or she was able to complete the operation, and he or she must have a strong immune system to be able to survive the process of dental modification and any infection that may have been encountered following the procedure.

Though costly signaling theory seems to help prove why dental modification occurs, it may not actually be the correct solution. It seems that humans do not look for mates in the same manner as most other animals. Male birds, for example, have flashy plumage that is used to catch the eye of a female bird which signals that he will be a satisfactory mate. Humans, though, do not look strictly at physical factors when choosing a potential mate. In fact, attractiveness may only elicit short-term desire in humans. Long-term relationships, rather, are based on an attractiveness to moral traits (Miller

2007: 97). Perhaps the first thing noticed when looking for potential mates are physical traits, so dental modification could make a person flashier and more eye-catching. Having a grill, though, will not ensure a mate. The grill, or other form of dental modification, may show that the signaler has money and resources, but this is not all that humans look for in a mate. What is a more reliable signal is human virtue because it cannot be counterfeit. A person may appear genuine for a short time, but the real nature of that person will eventually come forth. Positive signals that humans seek are generosity, kindness, honesty, courage, social sensitivity, political idealism, intellectual integrity, empathy to children, respectfulness to parents, and loyalty to friends (Miller 2007: 104). Even though humans may not follow costly signaling theory in the same manner as all animals, having a physical trait as a signal is still necessary since it is the first thing that a person notices. Additionally, when a high-risk procedure such as dental filing and inlaying is endured, it will show the positive signal of courage. Dental modification still follows the signaling theory, but instead of being a direct signal, it indirectly shows the receiver that the signaler is of high quality as a potential mate.

Conclusion

Intentional dental modification is a practice that can be seen in virtually all societies throughout history. Presently in the United States, the African-American population participates in dental modification practices by covering their anterior dentition with gold caps and grills. Other forms of dental modification that can be seen in the United States are the use of braces for straightening teeth, the placement of porcelain veneers over natural teeth, and solutions to whiten teeth. In many different societies in Africa, both tooth ablation and filing are still occurring. Dental modification, for these people, may be viewed as a source of pride or perhaps as a means to help identify with the group to which they belong. Modification of the dentition is also viewed as attractive to members of the opposite sex. In fact, by having risky procedures done to modify the teeth, people may be increasing

their likelihood of finding a sexual partner. This would be a benefit that outweighs the pain endured during the process, risks of infection that may occur afterwards, and the chance that the tooth could die and abscess from the oral cavity.

By looking at current societies and cultures that participate in rituals of dental modification, researchers may be able to determine the reasons why people in the past chose to participate in the painful processes of tooth filing and drilling with inlays. Even with the high risk of infection and knowledge of how easy it is to pierce the pulp chamber of teeth, people still endure these procedures. By looking at both cultural conformity and costly signaling theory, it becomes evident why dental modification has occurred for such a vast amount of time. If the majority of the people in a society are participating in dental modification, then it is likely that the practice will continue to occur. Also, dental modification will continue to occur in a society if members of the opposite sex find the outcome appealing. After all, according to Darwin's theory of evolution, the main goal of any living creature is to pass along his or her genes to the next generation.

Further research in this field needs to be done, and one way in which this can occur is by partaking in participant observation in societies in which high-risk dental modification is still thriving. Through participant observation, perhaps a dental modification ceremony can be witnessed so that the process can be fully documented. Also, interviews with people who have had their dentition modified could help shed light onto reasons why filing and ablation are still occurring.

Bibliography

ADA Division of Communications

2006 Grills, 'Grillz', and Fronts. *The Journal of the American Dental Association* 137(8): 1192.

Archetti, Marco

2010 Contract Theory for the Evolution of Cooperation: The Right Incentives Attract the Right Partners. *Journal of Theoretical Biology* 269(1): 201-207.

Avery, James K. and Daniel J. Chiego, Jr.

2006 *Essentials of Oral Histology and Embryology: A Clinical Approach*. St. Louis: Mosby, Inc.

Becker, Marshall J., Birgitte Ginge, and Pia Guldager

1989 Of Roman Extraction. *Archaeology* 42(4): 34-37.

Becker, Marshall J.

1999 Etruscan Gold Dental Appliances: Three Newly "Discovered" Examples. *American Journal of Archaeology* 103(1): 103-111.

Benedix, Derek C.

1998 A Biocultural Analysis of Intentional Dental Modifications. M.A. thesis, Department of Anthropology, University of Tennessee, Knoxville.

Bremner, M.D.K.

1958 *The Story of Dentistry: From the Dawn of Civilization to the Present...with Special Emphasis on the American Scene*. Brooklyn: Dental Items of Interest Publishing Co., Inc.

C.J.

1999 Scarification, Mutilation, Dental and Body Alteration.
http://www.uic.edu/classes/osci/osci590/13_4%20Scarification_%20Mutilation_%20Dental%20and%20Body%20Alteration.htm

Dentist.net

1999 *Streptococcus mutans*. <http://www.dentist.net/strep-mutans.asp>

Goose, D.H.

1963 Tooth-Mutilations in West Africans. *Man* 63: 91-93.

Graham, Elinor A., Peter K. Domoto, Heather Lynch, and Mark A. Egbert.

2000 Dental Injuries Due to African Traditional Therapies for Diarrhea. *Culture and Medicine* 173: 135-137.

Hollowell, W.H., and N.K. Childers

2007 A New Threat to Adolescent Oral Health: The Grill. *Pediatric Dentistry* 29(4): 320-322.

Ink Factory Tattoo

2010 <http://www.myinkfactory.com/index.html>

Jeger, F., A. Lussi, and B. Zimmerli

2009 Oral Jewelry: A Review. *Schweiz Monatsschr Zahnmed* 119(6): 615-631.

Logan, Michael H. and Hector N. Qirko

1996 An Evolutionary Perspective on Maladaptive Traits and Cultural Conformity. *American Journal of Human Biology* 8: 615-629.

Miller, Geoffrey F.

2007 Sexual Selection for Moral Virtues. *The Quarterly Review of Biology* 82(2): 97-125.

Orwick-Barnes, Susan

2010 Personal communication.

Reichart, Peter A., Ulrich Creutz, and Christian Scheifele

2007 Dental Mutilations and Associated Alveolar Bone Pathology in African Skulls of the Anthropological Collection, Charite, Berlin. *Journal of Oral Pathology and Medicine* 37(1): 50-55.

Roheim, Geza

1945 The eternal ones of the dream: a psychoanalytic interpretation of Australian myth and ritual. New York: International Universities Press.

Romero, Javier

1958 Mutilaciones dentarias prehispanicas de Mexico y America en general. Instituto Nacional de Antropologia e Historia, Mexico.

Scott, G. Richard and Christy G. Turner, II

1988 Dental Anthropology. *Annual Review of Anthropology* 17: 99-126.

1997 The Anthropology of Modern Human Teeth: Dental Morphology and its Variation in Recent Human Populations. New York: Cambridge University Press.

Scully, Crispian, and Nairn Wilson

2006 Culturally Sensitive Oral Healthcare. London: Quintessence Publishing Co. Ltd.

Smith, Eric A. and Rebecca B. Bird

- 2005 Costly Signaling and Cooperative Behavior. *In* Moral Sentiments and Material Interests: The Foundations of Cooperation in Economic Life. Herbert Gintis, Samuel Bowles, Robert Boyd, and Ernst Fehr, eds. Pp. 115-148. Cambridge: MIT Press.

Smith, Herman

- 1996 Maya Dental Mutilation. Dig It: Articles on Archaeology and the Maya on Ambergris Caye, Belize. Belize: Casado Internet Group.

Weisman, Gail

- 2010 Do It Yourself Reverse Orthodontics. Dental Compare.
<http://www.dentalcompare.com/Blogs/?tag=/tongue+piercing>

Woodforde, John

- 1968 The Strange Story of False Teeth. New York: Universe Books.

Wynbrandt, James

- 1998 The Excruciating History of Dentistry: Toothsome Tales and Oral Oddities from Babylon to Braces. New York: St. Martin's Press.