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# Archetypal image of the teeth – Stimulating certain understandings for the appreciation of the biting wit \*

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## Abstract

There are meanings which were [are] attributed to the archetypal image of the tooth, honouring how dynamic operations of the biological (chemical and physiological characteristics), emotional, and behavioural aspects of its existence and organic manifestation impacted the understandings that some ethnic communities, ingrained in their own ecological, geographic, religious, historic, and cultural factors, built and developed through their approximations to teeth. That can be possibly seen as scaffolding the innumerable, stable and/or modified symbolic representations that constitute the emerging narratives modern humans manifest and exchange when having the tooth as the object of their current experience and enquiry. It discusses individual, collective, and transpersonal states of feeling and reasoning that analyse the possession and the observation of teeth and the phenomena related to their utility, appearance, state of wear, and identitarian judgements that can be drawn from their materiality. Hence, this literature review discusses how the practise and/or attribution of rituals for modification and/or mutilation of teeth, socioeconomic expectations, cultural meanings, self-identity information, dietary styles, and crimes that surround the human dentition have occurred and insist to occur throughout the conscious and/or unconscious transmission of ideas and ideals that are attached to the image of the tooth, revealing a certain common yet transformed knowledge between traditional and modern societies.

**Keywords:** archetypal image; tooth; symbology of the tooth; enamel; ethnic groups; rituals

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## Introduction

Since ancient times teeth were an aspect of the human or other worldly species body that inspired the human consciousness to elaborate meaning to express their materiality, significance, and utility. These significances represented more than and/or support some of the prevalent meanings that the postmodern mind can currently assign to them. Most likely modern humans are probably not fully cognizant of these significances, and mainly relate to teeth in superficially associating their meanings as solely linked to the concepts of purpose and self-identity, such as teeth being tools for eating, or instruments that can determine the age, gender, levels of oral care and hygiene, and socio-economic status of their owner.

Hence, in this literature review we compile information on how teeth in traditional societies were embedded in the immanent and transcendental beliefs and thoughts that emerged through the interrelationship of socio-historically situated ethnic human groups in a way that was not guided by scientific claims, but by myths, metaphoric meanings, and symbolisms that attempted to define their existence for beyond their physicality. This information is wholly correlated with some ways in which update scientific discoveries may have been possibly guided by folk knowledge to deliver academic evidence that empirically support the affective-symbolic knowings that our ancestors physically and conceptually drawn from the archetypal image of the tooth, by associating its comprehension with their need for adapting to specific biological, social, and physical nuances of their local ecology.

In this sense, we discuss the mental representations that circumambulate the materiality of the tooth accentuating the affective, physiological, emotional, and perceptual aspects contained in and evoked by it, that is, the flesh and body dimensions of it as experienced in one's actions to one's teeth and in his/her interactions with others when having their teeth at the focus of his/her analysis, as scaffolding conceptual and symbolic meanings that individuals associate to their own teeth, those of their enemies, of significant others that were loved and/or revered by them, of animals that shared their environment and that incarnated certain desired and/or feared characteristics through their analytical judgement.

Hence, we extract from the complexity and plurality of these narratives on the tooth the singular relationships that people, individually

and collectively, have[had] to the concepts of time, politics, wealth, health, beauty, ritual, developmental stages, religiosity and/or spirituality. This systematic review of literature reports on these various meanings in a way that exposes the archetypal image of the tooth, without claiming to be a comprehensive review as the many sources utilised as literature for this writing are far too vast to cover up for that. Rather, it offers an honest starting point to illustrate some of the major issues that intersect our investigation, so that those interested in the subject can begin to explore this massive body of work.

Furthermore, it is essential to state that this essay is the first of a dilogy, that is, it will be followed by a subsequent publication, as its entire length prevents it from being published in full. Thus, in the following sections we present some fields of experience that united describe the biological materiality of the tooth, its manifestation within the phenomenological reality, suggesting hypotheses that illustrate how these can be thought as if rooting certain affective-perceptual and cognitive perspectives on dealing with the possession, the sight, the use, and the interpretation of the tooth, without forgetting to highlight that some explanations of these fields overlap in affirming the tooth as being a representation of a certain meaning within a determined culture, or cross-culturally.

## The biology of teeth and its symbolic reverberations

Organically speaking, teeth are what we practically use to take in the external world, through the function of feeding oneself, that is, drinking liquids and/or masticating, breaking the solidified form of food down into something that, for the fragmentation of its parts, becomes capable of being introduced into the digestive system of an individual, that then is enabled to manipulate that which has lost its wholeness so that is made ready to be absorbed in order for one to survive and/or thrive. In an analogical way, this could be associated with the discriminative capacities of the mind while receiving and predicting the perceptions and emotions it gathers from the world, coding its information and attributing meaning according to the developmental, socio-historic, and psychological conditions of its observer, that is, birthing thoughts, digesting the meaning, value, and/or quality of the interactive data in a way that is functional/adaptive or not.

Through another analysis, teeth are part of the orofacial structure – participating in mechanical interaction between the tongue and palate – that enables the individual to express her inner reality upon the outside world, as they play an important role in speech production, that is, the manifestation of one's sounds. According to Bankson and Byrne (1962) 'the teeth and dental arches, together with the tongue and lips, play a significant role in constricting or opening the passageways through which the air passes during speech' (p. 341)(1).

In this sense, it must be considered that the dynamic association of lip-teeth as delivering personal expressions also contributes to the clarity or distortion of understanding that is reached through speech. Johnson and Sandy (1999) state that 'certain dental irregularities show a relationship with speech disorders' (abstract) and that even though analysing individual malocclusion traits is essential, it must be observed that 'some sounds seem more sensitive to alteration of the oral structure than others' what might be related to 'the order of difficulty of individual sound production, since the sounds acquired last are those most often reported as distorted' (Ibid., p. 309)(2).

In this way, teeth have their importance in giving sound substance to the contents that permeate one's elaborations of the realness of reality. In the cosmogonic view (creation myth) that derives from the Dogon mythology, that is originated from this ethnic group living in Mali, West Africa, the element of tooth appears as Amma's door, being Amma the god/goddess that 'was the unformed universe, a body that is said to have held all of the potential seeds or signs of future existence' (Scranton, online), and who created life on earth. According to this mythology, the Master/Mister of Speech was sacrificed in front of the 'door of the world', in an event in which 'he/she lost every other one of his/her teeth, in alternate rows', and 'at that moment the word began' (p. 105)(3), that is, this was the instant in which speech was revealed to humans.

Furthermore, in observing the bio-physiological composition of teeth, they are mainly made of human calcified tissues – cementum, enamel and dentin. Bartlett (2013, p. 1) explains that 'cementum is found along the tooth root and primarily serves to hold the tooth in place by binding collagen fibers (Sharpey's fibers) that are continuous with the principal fibers of the periodontal ligament'(4). According to Gutiérrez-Salazar and Reyes-Gasca (2003):

'tooth enamel is the most mineralized tissue of the human body. Its composition is 96 wt% inorganic material and 4 wt.% organic material and water. In dentin, the inorganic material represents 70 wt.%. This inorganic material is mainly composed by a calcium phosphate related to the hexagonal hydroxyapatite' (p.367) (5).

This means to say that the enamel of a tooth is the hardest and most resistant to deterioration substance of the human body. While the enamel layer covers the crown of the tooth, a thick dentin layer, softer than enamel, forms the bulk of the tooth, 'having an elastic quality that provides flexibility that prevents fracture of the overlying brittle enamel' (Bartlett, 2013, p. 1)(4).

Analysing this information through a scientific standpoint, we must comment on how these factors influence the practice of forensic odontologists in processes of dental profiling, as teeth may remain more or less intact for many years beyond death because they are not changed by postmortem decomposition and usually withstand to flames, alkalis or even to weak acids(6).

Through the perspective that approaches this same phenomenon via an archetypical understanding, we could discuss the ways in which teeth symbolise physical and/or spiritual strength, that is, based on the concrete standing of one's social status as a hunter and/or a warrior within a collective group. In relation to the use of animal's teeth as pendants, Dijkstra (2010) explains that 'hunting difficult animals must have been more prestigious than hunting normal animals and the teeth of these difficult animals then functioned as trophies – as tangible symbols of a successful hunt – that bestowed a high status upon their owners' (p. 256)(7). In this way, it must be observed how, throughout history, and in many ancient ethnic groups, teeth have been culturally used 'as tools, as body decoration, medical instruments, amulets, relics, as drugs and remedies, prophylactic agents, trophies, souvenirs, and as objects of value' (Alt et al., 1998, p. 29)(8).

In prehistory, the employment of perforated human teeth as pendants is very rare; nevertheless, those objects were found in middle neolithic burials in Northern Italy. This is a new phenomenon compared to northern Italy first Neolithic and the most common teeth are the canines of canids. Also, it shows a preponderance of wild animals such as fox, wolf and wild cat over domestic animals such as dog. It is believed that this use is not only decorative and could represent symbolic values such as a

direct link with the person to whom the tooth belonged, as in the wearers being biological descendants of her/him, the function of being amulets against magic and illness, or signs of affection. It is worth mentioning that necklaces that included animal teeth were worn by women, but this type of ornament does not seem properly representative of the female sphere, but its meaning can be linked to the display of their male relatives' status. Also, necklaces with performed teeth would also include arc-shaped shell pendants, probably imitating carnivores' large canines or claws(9).

In relation to humana, according to Mckeown and Bennet (1995), 'the anterior dentitions of cadaver were observed to discern patterns in "drop time" based on age, periodontal health, seasonality and location of body placement' (abstract)(10). In cases in which teeth were extracted from a deceased individual, this practice mainly aimed to disable the destiny of her/his soul in the after-life, making the possessor of her/his remains [his enemy] superior to him throughout eternity, for by continuing to wear a bodily part of the dead, warriors reminded themselves of the power they had over their oppositors. Jacobi (2003) explains that, along history, the dismemberment of a body is 'directly related to the intent of individuals or groups to prevent the recipients of the trauma from coming back from the dead [to punish the living], or to prevent these individuals from attaining a particular spiritual place' (p. 96)(11). These beliefs might be connected to the idea that for the soul to cause harm to those still incarnated, that is, to become a malevolent spirit, it should disincarnate from an entirely preserved body, that, in this way, would emphasise the inseparability of body and spirit held by these ancient ethnic groups, or to the conceptualisation that, for it [the soul] to be admitted into realms of the after-life its spectre should have been whole, as if to show accordance, merit, and/or belongingness to the wholeness/sacredness of this imagined sphere of existence, where probably the forms that constituted it claimed for the concepts of perfection, integrity, and/or purity. Weiss-Krejci (2013) exemplifies how these beliefs echoed through the narratives and practices of many different peoples, adding that: In ancient Greece, it was believed that cutting the extremities from the corpse could prevent the vengeance of a murder victim on its murderer. [...] In medieval and pre-modern Europe, witches and heretics were burned at the stake. People believed that this would inhibit the chance of resurrection. In the past the Andaman islanders

cut their killed enemies into pieces and burnt them. The goal was to get rid of their blood and fat so they could ascend to the sky and were no longer a danger to those who had killed them (p. 286)(12).

In exposing the finding of skeletal remains of a Native American man of the southeast who was possibly a shaman, Jacobi (2003) explains that the necklace made of 100 adult teeth that belonged to him 'could have been the teeth of enemies, and they probably served as trophies that represented the individual's powers over other living or dead individuals' (p. 103). Furthermore, it is also important to state that military personnel in more modern times continue to desecrate the bodies of enemy soldiers to obtain trophies, displaying behaviour that violates military regulations, as clarified by Bryant (2003) who explains that 'in world war II, some Americans GIs collected teeth [...], from the bodies of dead Japanese soldiers' (p. 979)(13). Currently, the practice of thanatological crime is seen as consisting of four motivational categories which are '(a) functional/instrumental' in which acts are 'purposeful, rational, and functional beyond, or in disregard of, economic gain', (b) 'malicious mischief/amusement', in which the acts are committed 'because they are "fun"', (c) 'profit/economic advantage', and (d) 'pathological/compulsive', in which the thoughts that lead to behaviour are 'irrational and aberrant' (p. 976–7)(13).

An additional note that is worth considering refers to how researchers differentiate whether teeth that belonged to a third party but are found together with specific human remains derived from acts that aimed to violate another human being or served to initiate him/her into ceremonies in which the intentional dental ritual of mutilation (tooth knocking-out) was performed. Allied to this couple of assumptions, Jacobi (2007) clarifies that there are also other two thinkable possibilities to be investigated on the background history of the teeth that emerge together with remains to whom they do not belong, and these speculate whether the deceased was a prehistoric dentist and, hence, have extracted the found teeth to promote healing in other individuals, or a 'bone picker', that is, someone who scavenged and deliberately collected teeth for his own private appreciation and collection(14).

In explaining the cues that orient this assessment, Jacobi (Ibid.), supported by the claims of other researchers, explains that when teeth derive from the collection of souvenirs in the

battlefield, that is, when they were gouged from the dead mouth of an enemy, they generally present 'evidence of fracture in the attempt to extract the teeth from the enemies' (p. 319). In case the researcher suspects that the teeth were extracted in social rituals of initiation she/he examines if they are incisors and canines. When the skeletal remains are thought to have belonged to a prehistoric dentist it may happen that his dental 'tool kit' was interred with him, or that the teeth found in his company would be diseased, that is, 'there would be evidence of caries development or abscessed roots' (Ibid., p. 318). Finally, if the hypotheses is that the remains pertained to an archaic bone picker, the teeth would have been chosen by their aesthetic value, 'as selected prizes that symbolise his profession as well as mementos representation certain individuals in his prehistoric society' (Ibid., p. 319).

In considering cases in which teeth were lost before death [antemortem tooth loss, AMTL, henceforth] and not as an effect of violence, it is important to keep in mind that the incompleteness of the body to which they belonged would still be seen as a form of impairment for the soul to journey toward the afterlife, hence, the ethnic community of the deceased would still apply specific burial and/or funerary measures to aid this soul to reach its final 'destination'. Weiss-Krejci (2013) in citing the research of Ucko (1969), who studied the Nandi of Kenya, reveals that the deceased of this population had generally their bodies put out for the hyenas to eat them [and this exposure was not a sign of negative feelings towards the deceased], for hyenas would serve as vehicles for their souls to leave the earth, however, in case they were very old and had lost their teeth, or were very young and had not received first teeth, their bodies were buried in the ground from where they could possibly reach the spirit-land without the mediation of hyenas.

Thus, it must also be considered how the phenomenon of edentulism, defined as the absence or complete loss of all permanent dentition [caused by dental diseases, caries and/or periodontitis], would be associated to the loss of strength in an individual, be it physical, social, political, and/or spiritual, what would then accentuate the tooth as a symbol of the directly opposed pole of strength, that is, weakness [associated or not with one's aging process], concretely experienced by the individual while dealing with one's own toothless existence within a human group, especially in times in which the

wearing of [in]complete dentures was an impossibility.

Dental caries are a major oral health problem in modern human societies but were also problematic in ancient times. Tooth surface easily loses some tooth minerals from the action of the acid formed by plaque bacteria after ingestion of foods containing fermentable carbohydrates; the latter can low pH in the plaque which is favorable to aciduric organisms, such as *S mutans* and *lactobacilli*(15), which in fermenting under it in a dental plaque decalcify the portion of enamel exposed to them and a carious lesion is firmes, but those bacterias cannot survive death. However, the oral cavity harbors one of the most diverse microbiomes in the human body and play a key role in human decomposition with the potential to estimate postmortem interval(16)

It is important to note that when the human race started to experience the painful process derived from dental caries some justification for their occurrence needed to be formulated, and as magical thinking was a way of explaining what was unexplainable when considering the epistemological conditions many societies had for accounting to the phenomenology of happenings, it appeared the notion that they were derived from the toothworm. According to Barnes (2010):

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. The earliest record of the story of the toothworm was found in the royal library in Babylonia [which dates back to 3000 BC] (p. 5)(17).

To improve pain relief, medieval treatments were based on herbal remedies or anatomical principles. Ancient Greeks, Egyptians and mainly Romans were acquainted with caries removal by drilling and cleaning the infected cavity(18). However, the prevalence state of periodontitis has a more extensive reach than dental caries in the ancient population because the combination of serious carious lesion and tooth attrition caused the periodontal abscess sclerotic deficiency(19).

Emami et al. (2013) state that, nowadays, 'studies show that edentulism is closely associated with socioeconomic factors and is

more prevalent in poor populations and in women' and expose that 'factors contributing to the prevalence of complete tooth loss are age, education, access to dental care, dentist/population ratios, and insurance coverage', being that 'edentulism can lead directly to impairment, functional limitation, physical, psychological, and social disability, and handicap' (p. 1)(20).

In this sense, it must also be observed how chronic infections, including periodontal infections that can lead to edentulism, may predispose to cardiovascular disease. The study of Joshipura et al. (2002) affirms that 'two case-control studies and 4 longitudinal studies have evaluated the association between oral conditions (periodontal disease and/or tooth loss) and stroke, and 4 of the 6 have significant positive associations' (p. 47)(21). Li et al. (2000) accentuate that 'periodontitis, may affect the course and pathogenesis of a number of systemic diseases, such as cardiovascular disease, bacterial pneumonia, diabetes mellitus, and low birth weight' (p.553)(22). According to Li et al. (ibid.), great attention must be paid to the overall health of the mouth for its impact upon the whole functioning of the organism, as findings that clarified the classification of microorganisms which are present only in the oral cavity unveiled a systemic dissemination of infection that occurs from the mouth towards '[...] distant body sites, especially in immunocompromised hosts such as patients suffering from malignancies, diabetes, or rheumatoid arthritis or having corticosteroid or other immunosuppressive treatment' (p. 547). Moreover, the study of Friedman and Lamster (2016, abstract), who specifically addressed two critical questions, which were: A) 'can we conclude that the number of teeth in aging humans can affect longevity and life expectancy?' and B) 'is tooth loss a predictor of shortened longevity?' had a positive answer to both questions(23). Finally, the research of Bergdahl et al. (2007) that examined the relation between dental status and cognitive performance found that the presence of functional natural teeth relate to relatively preserved cognitive functioning in older age (abstract)(24). This finding is supported by the studies of Saito et al. (2018) that affirms that tooth loss may be a predictor or risk factor for cognitive decline (abstract)(25), and Dintica et al. (2018) that suggests tooth loss as a risk factor for accelerated cognitive aging(26).

In approaching reasons for AMTL in prehistoric peoples, which provides an evolutionary and

ethnographic context for understanding oral health in modern humans, Lukacs (2007) adds that, in general lines:

Variation in the consistency of food due to its toughness and to food preparation methods is a primary factor in AMTL, with dental wear or caries a significant precipitating factor. Nutritional deficiency diseases, dental ablation for aesthetic or ritual reasons, and traumatic injury [derived from accidental falls and/or interpersonal combat, mainly causing anterior dental trauma and tooth loss](27) may also contribute to the frequency of AMTL (abstract)(28).

The study of Russell et al. (2013) adds to the list of factors that contribute for the occurrence of AMTL, including into it the variable of sex/gender differences, as 'caries and tooth loss [were] more common in women than in men' (p. 319)(29). In what regards the dietary changes [and consequent alterations connected with food preparation and storage technology](30) from one socio-historic ethnic group to another, it is important to consider how changes in life conditions and patterns of behaviour directed toward subsistence, that is, the socioeconomic organisation of different populations within situated localities is interconnected and interdependent with an increased prevalence of dental caries. This correlation echoes from the increased intake of sugar and carbohydrate-rich foods made possible by the advent of agricultural practices when compared to the hunter-gatherers' diet that were derived from animal food sources(31, 32).

Some other researchers, who criticise the excessive focus on the correlation of dental indicators of oral health with subsistence strategies recommend that allied to these numerous lifestyle analyses that, in their perspective, oversimplify data for accentuating 'intergroup variation at the expense of intragroup variation', it must be observed aspects such as 'climatic factors (mean temperature, annual temperature, and precipitation)' (abstract)(33), 'ecosystem management' that populations applied to their specific localities, and an analysis of their 'nondietary usage of the teeth', that can be thought of as 'the use of teeth as a third hand' (abstract)(34). These aspects could aid to explain much of the variation in tooth condition in populations before and after the agricultural revolution, revealing other reasons for the prevalence of specific dental pathological lesions and not others.

Finally, when considering AMTL as a sign of health disintegration, and observing that many

traditional nomadic societies (hunter-gatherer) had to ensure group survival in possibly unforgiving environments, hence, taking the age of their integrants as a foundation of physical capacities to continue to move or to feed themselves and occupy certain ranks within the community (social organisation), we must approach the discussion of the neglect, abandon [both characterising death-hastening behaviour], or even life termination [geronticide] of the elderly when they could no longer keep up with the group's movements, the fluctuation of food supply was threatening, calamities [wars] happened to the tribes, or they were affected by decrepitude, becoming the elder a 'burden' for the well-being of the larger community.

Brogden (2001) demonstrates many cases in which the process of death-hastening was performed within nomadic tribes, as occurring amongst the Amazon Bororo (in citing Levi-Strauss 1936), the Bolivian forest-dwelling Siriano tribe (in citing De Beauvoir, 1973), and the Niue from Polinesia (in citing Barker, 1990), performed through the denial of food to their elderly, and the Lau people in Southern Fiji (in citing Simmons, 1945), the Eastern Cape Thonga (in citing De Beauvoir, 1973), the North-american Hopi, Creek, Crow First Peoples, and the Amassalik Inuit, by abandoning the elderly destitute in inauspicious places in where they were unable to fend for themselves; while geronticide practices happened within certain Siberian peoples, and North-american tribes (in citing De Beauvoir, 1973)(35).

In continuing with the discussion that addresses the biology of the tooth, Goldberg et al. (2011) explain that 'teeth contain in their central part dental pulps, which are usually non-mineralized. This soft connective tissue also contains nerves and a vascular network connected with the surrounding tissues, the periodontal ligament and the bony socket.' (p. 711)(36). These biological characteristics here described, that compose the structure of a tooth, expose the living and the inorganic constitution of it, what inspires the mind to think of its dual nature, that is, in which the tooth could be seen as a human sensory organ that is intrinsically "dead" and alive, mineral and animal. In the odontological sense, this observation must also entail the consideration that, for being of a paradoxical existence while connected to the mouth of a living being, the tooth is also capable of confronting the death of its owner in a very particular way, as it is not gradually extinct in it together with other organs and bones.

In what relates to their shape and function, the anterior teeth are called incisors (two central and two lateral incisors on each arch) and their role is to cut food into smaller pieces, without performing any grinding function. Moving posteriorly, the next tooth is the canine (two on each arch), also known as the cornerstone of the dental arch because of its role in helping to control how the teeth slide off each other, a part of tearing the food. Next are the premolars (four on each arch) followed by the molars (six on each arch including the wisdom teeth) that assist in grinding and mixing food(37). For a tooth to be graded as healthy it had to have a hard, smooth, shining surface devoid of markings, pits or fissures.

In relation to the symbolism of the number 32, it is important to cite that in the Kabbalah there are 32 Kabbalistic Paths of Wisdom. This is, in turn, derived from the 'arrangement of ten interconnected spheres, or Sephirot', [that form the Sephirotic Tree] and 'represent the attributes that God created through it he manifests the physical and mystical universe', being that these Sephirot 'are connected by 22 channels or paths, representing the 22 letters of the Hebrew alphabet' hence totalising these 32 paths, 'that derive from the first 32 verses of Genesis, in which the name of God (Elohim) is mentioned 32 times' (p. 75)(38). In addition, from the Buddhist tradition we find in the Prajñāpāramitā Sūtras, a collection that consists of about forty texts, which were composed in an unidentified locality on the Indian subcontinent between approximately 100 BC and AD 600(39), the listed description of the 32 physical characteristics the – 32 signs of the great man – and the 80 minor physical marks regarding the bodily features of the historical Buddha(40), which mark his physical excellence. Finally, from the Hindu tradition we have the number 32 associated to the Hindu scripture 'Ganapati Upanishad', in which 'Ganesha [a deity with an elephant head] is called the 'Supreme Self', and in where '32 different icons [to represent him] arose, to which different people pray to different icons according to what aspect they consider to have the most significance' being that, 'out of these 32 forms, certain specific icons gained more popularity than the rest, based on what they depicted, provided and represented' (p. 10–1)(41).



### Teeth as witnesses and proofs of the passing of time – their recording of environmental events, ageing, and developmental stages/life transitions

Nowadays, it is known that teeth act as a biological marker of aging and record environmental and traumatic events, as well as the effects of disease. This means to say that the development of the dentition is highly integrated into the life cycle of human individuals, the slowest-maturing primates, being that 'humans show the longest lag between birth and emergence of the first tooth, [that is], 0.629 years, just over 7 months' and 'not completing the deciduous dentition until 2.3 years' (p. 190–1)(42). This 'set of milk teeth erupts before, at, or soon after birth and lasts through the nursing period, allowing young mammals to learn to eat an adult diet' (p. 137)(43). The permanent dentition begins by the age of 6 years with the emergence of the first permanent molar(M), which is used as a baseline measure of somatic maturation, however, Smith et al. (1994) add that 'for males of some, but not all, human populations, I (incisor), has come to tie or barely precede M' (p. 192)(42). Overall, it is important to consider that the times of eruption of teeth are fairly constant and that this regularity can be applied in ascertaining the approximate age of an individual.

The reason for that is that these times of dental eruption are tightly correlated with aspects that constitute life cycle variables for the individual such as attaining an approximate 'brain size , age at first reproduction, lifespan and other life-history traits' (p. 628)(44). Rozzi (2016) expands the list of these variables, in citing Smith years, by exposing that '[...] age at the first molar eruption is highly correlated with age at weaning, age at female sexual maturity, interbirth interval, [...] and, in male primates, [and] age at sexual maturity ' (p. 1)(45). For comprehending the nature and quality of these occurrences for individuals through the analysis of their teeth it is necessary to understand that enamel and dentin are investigated by researchers, being that the former 'precipitates during childhood and juvenile age and is not remodelled thereafter', that is:

When the dentition develops, the crown of the tooth is formed first, and the following growth of the root leads to the eruption of the tooth into the mouth cavity (Grupe et al., 2015). Dentin thus precipitates later than enamel but still during childhood and juvenile age [being that dentin once formed is only remodelled to a minimal

extent during lifetime compared to the bone] (p. 197)(46).

Hence, in taking into account this information, it must be noted that tooth development and mineralisation are processes that derive from different tissues interactions that are responsible for the formation of unique structures with a particular chemical composition. The biological processes of formation of these two hard tissues are respectively called amelogenesis and dentinogenesis, being interdependent(47).

Both enamel and dentin are key archives for the reconstruction of past environments. In this literature review we briefly address two techniques applied for reconstructing information of the aspects that constituted the nutritional and health status, the levels of stress, the environmental and climate conditions, cultural influences (such as betel chewing), and the consequences of the economic changes that characterised the lives of individuals who had their teeth analysed for defining details of stories unknown to us, revealing how their psychosocial conditions were detrimental to their growth and development or not. The first analysis is accomplished by investigating the recorded chemistry and isotopes of one's teeth. According to Pellegrini (2016):

The use of isotope geochemistry techniques to trace mobility of individuals relies on the fact that the chemical composition of human (and animal) tissues is acquired principally through ingested food and drink, and the isotopic composition of these items is in turn determined by local climate and environmental conditions. Isotope ratios such as  $^{18}\text{O}/^{16}\text{O}$  and  $^{87}\text{Sr}/^{86}\text{Sr}$  are employed in soft and hard tissues to investigate origins and mobility of past populations. The relationship between the isotopic composition of local environments and the different biological tissues varies with the type of element and isotopes investigated, the tissue, and often the type of animal species (p. 1)(48).

The second investigation that can extract information from teeth derives from the fact that the sequentially mineralizing tooth tissues that form enamel and dentine provide a continuous incremental record of the tooth growth, as if tree rings, which becomes concretely embodied within the microstructure of them. In this sense, Dean (2010) clarifies that:

The cells that form enamel and dentine (ameloblasts and odontoblasts) secrete their matrix in a rhythmic manner. A circadian rhythm in cell function is expressed as a daily slowing of secretion during enamel and dentine formation

and is still manifest in the enamel and dentine microstructure of fully formed teeth as a daily incremental marking. [...]. Counts of daily incremental markings in the teeth of individuals with known dates of birth and death match very closely with the number of days of life (p. 3397-8)(49).

Hence, considering that when the tooth forms its layers record daily and weekly growth, these data can provide a basis for estimating age of tooth formation and emergence, as they are independent maturational processes. This characteristic of teeth is utilised by forensic anthropologists and dentists to determine the individual calendar age at the time of death, which entails the use of a variety of biochemical, morphological and histological techniques.

The application of these methods varies according to the categories such as fetus (prenatal and neonatal), children, adolescents and adults. The overall assessment of tooth development is effective till ages 14-16 years. After that age range, only third molars can be assessed till the age of 21 to 23 years (50). For this reason, third molars are also called 'wisdom teeth'. The increase in the prevalence of impacted third molar teeth increased over history and one of the theories is that evolution of the third molars in the longer jaws of the human ancestors reveals the benefit of these teeth may have added to dentition millions of years ago. Moreover, it was found that modern societies possess higher prevalence of temporomandibular joint dysfunction. The proposed mechanical theory is an added value to explain the impact of modernization on the prevalence of impacted third molars(51).

In addition, as amelogenesis [enamel formation] – which begins 'at the occlusal apex of each tooth crown and proceeds rootward, ending where the crown meets the root at the cervicoenamel line' – is a process in which stress to the organism can result 'in a temporary upset of ameloblastic activity and a consequent enamel defect marking the interruption of development' (p. 329)(52), caused by a reduction in the thickness of the enamel surface, the presence of these defects are silent evidences of physiological disturbances undergone by the individual.

These so-called enamel hypoplastic defects, that occur during the development of deciduous teeth [and permit the evaluation of the approximate developmental age in which they occurred], can take many forms, ranging from single pits to lines to grooves [which cover the surface of tooth crowns, and constitute the condition named

enamel hypoplasia](53), and are appointed by Cook (1980) as signalling disruptions to enamel formation that occurred not derived from genetic factors or topic, local traumas as these are usually identifiable(54). Goodman (1989) affirms that these 'defects are associated with decreased longevity [as] individuals with defects have a life expectancy of nearly ten years fewer than those without defects, suggesting that the development of a defect marks a significant and lasting health event' (abstract)(55).

In exemplifying some studies that utilised these both techniques to assess information on the lives of populations it can be cited the research of Smith et al. (2018)(56), and that of D'Ortenzio et al. (2016)(57). The former used evidence found in teeth from two Neanderthals from southeastern France (analysed with lasers to sample the teeth's layers and reconstruct the past exposures to chemicals along their incremental markings), detecting biogenic metal incorporation that parallels tooth growth, having measured barium, lead, and oxygen in these teeth for evidence that investigated aspects such as nursing, weaning, chemical exposure, and climate variations across their growth rings. Smith et al. (Ibid.) concluded that:

Although it is unclear whether and how cold stress or neurotoxicant exposure routinely affected the health of Neanderthals, scholars have noted the frequent occurrence of developmental defects in their teeth. Several common explanations for these defects, including weaning stress and illness, can now be probed through developmentally informed barium mapping (p. 7)(56).

In this way, the elemental analysis of the teeth revealed short-term exposure to lead during cooler seasons, possibly from ingestion of contaminated food or water, or inhalation from fires containing lead. The study of the latter, D'Ortenzio et al. (2016), which analysed archaeological skeletons from St. Matthew and St. Marie, Quebec (1771–1860), and St. Jacques, France (1225–1798), shows 'that systemic mineralisation problems of individuals with [vitamin D] deficiency may cause dentin mineralisation to stop or falter, preventing further dentin growth and fusion', affirming that 'dentin has the potential to enable past episodes of vitamin D deficiency to be recognized' (abstract)(57).

In speaking of the emotional and symbolic meanings that the transition from deciduous to permanent teeth (involving tooth loss and/or removal, and regrowth) can have for the children

who undergo this transformation – at around 6 year-old – or for the parents and/or caregivers who accompany this process as empathetic witnesses, it must be said that throughout time and across cultures the self-awareness of this biological cycle has had different significances attributed to it, yet, conserving its status of being recognized as a rite of passage. In ancient societies, Townend (1963) exemplifies that nine different rituals and/or specific methods were applied to ceremonially dispose of the first deciduous tooth extracted or lost, which could be performed by 1) throwing the tooth into the sun, 2) into fire, 3) between the legs, 4) onto or over the roof of the house, 5) placing it in a mouse hole, 6) burying it, 7) hiding it, 8) carefully placing it in a tree or on a wall, or 9) having the mother, child or an animal swallow it(58). These actions generally involved the chanting of incantations during their operation, which would work as if ‘an audible plea for help to get a new and better tooth to replace the lost one’(59). In this sense, Hingston (2014) clarifies that:

Perhaps the most widely practiced ritual, one that has been documented everywhere from Russia to New Zealand to Mexico, involves offering the lost tooth as a sacrifice to a mouse or rat, in the hopes that the child’s adult teeth will grow in as strong and sturdy as the rodent’s — a wish for transference that anthropologists call “sympathetic magic”. This offering is often accompanied by a specific prayer or song, and, in a pinch, any strong-toothed animal will do. Leo Kanner’s “Folklore of the Teeth,” from 1928, records similar ceremonies involving cats, dogs, squirrels and beavers (online)(60).

Hence, we see through these coordinated actions an attempt of symbolically gaining the empathy, the affinity, and/or the protection of an animal as a guarantor that one’s teeth will, by correspondence, acquire the qualities of strength as shown in the biology of the animal, since an alliance is enacted from the individual who aims to gather these qualities in oneself, by forming this embodied, performed, and orally manifested “pact”.

In modern cultures the disconnection of deciduous teeth from the mouth of a child is seen by some psychoanalysts (following the hypotheses established by Freud, 1924)(61) as a physical reminder of the resolution of the Oedipal conflict – in the male child – and of the Electra complex (Jung, 1913) – in the female child (phenomena that, at their most basic levels, can be approached as the development of a psychic, mental representation of a central, consuming,

and instinctually driven, triangular conflictual and competitive constellation of affectively charged child-parents relations, occurring during the child’s phallic stage of psychosexual development, that is based on an unrealizable yearning in the boy who regards his mother as an erotic object that is taken as his own property, based on her love and care for him, and lives through early anxieties of having his central importance in her life as if dangerously transferred to the father, expressed by the boy as a hate towards him, and by the girl who tends to feel an erotic desire for her father while experiencing a sense of rivalry and/or ambivalent love with her mother, expressed by the girl as a jealous attitude)(62).

In addition, Arnold van Genneep (1960) accentuates the cyclic and regular phases that are undergone by children while experiencing the literal disconnection of a part of their bodies as a result of the body’s own development – as having to disintegrate an aspect of itself to be made more adapted – in terms of separation, transition, and incorporation(63). In a further analysis, these stages can be seen as a lived experience and as a metaphor for the many further transitional movements of the life cycle itself that will come to pass in the lifespan of the individual, in which an ending of one stage in one’s life is requested in order for she/he to develop and grow into another phase, in which more responsibilities and awareness of oneself and of one’s environment and interrelationships will be required.

In this sense, by confronting loss, regeneration, and wholeness, through the loss of one’s tooth, the child gradually feels, experiences, and internalises that the prelude to the obtaining of the possession of a better developed version of one’s tooth, is preceded by a period ‘in between’, of waiting, accommodating, and accepting the space of the absence that is left behind in the process, being the ‘gap’ in this way a reminder that one is over the threshold but not through to the other side, in which there is this lack of certainty whether this stage is the beginning or the end, until it occurs the culmination of the new. In relation to the teeth’s appearance, as, in general lines, studies of eye movement have shown that face perception and recognition involve a typical triangular scanning pattern, with the main emphasis on the eyes, nose, and mouth – targeting a T shape or a triangle shape, that is, focusing on the internal facial features, and suggesting that eye movements are determined by the structure and content of the stimulus one observes(64-66), it is important to discuss how

the impact that teeth, as undissociated from the mouth that frames and exposes them when opened, have on the socioeconomic, cultural, and aesthetic evaluation individuals make of their owners. Hence, being part of the average 'map' externally used to initially and unconsciously, intuitively, or consciously classify and recognise certain characteristics as present and/or absent in the personality of their owner, the emotional and/or cognitive judgement that teeth receive can influence the quality of social interactions and the biopsychosocial health one enjoys. According to Boeira et al. (2016):

Studies have found that the satisfaction with dental appearance is greatly influenced by tooth color and malocclusion. Those parameters could be affected by psychosocial, cultural and sociodemographic factors. White teeth have been associated with higher scores of social competence, intellectual ability, psychological balance and social status and may impact the quality of life of the subject (p. 9)(67).

Ibiyemi and Taiwo (2011) explain that the tooth's colour 'varies from white to creamish yellow. It is lighter in children and becomes darker as age increases. The tooth can be discoloured by deposition of pigments in its internal structure and on its surface' (p. 94)(68). The tooth's natural colour is mostly determined by the dentine(69), as 'enamel is relatively translucent' (p. s2)(70), and both tissues respond to a process of light scattering and absorption within them.

In considering that teeth become yellower with age, Hendrie and Brewer (2012) add to the implications of this darkening of teeth by signalling that 'whilst the teeth of both sexes act as human ornament displays, the female display is more complex because it additionally signals residual reproductive value' (abstract)(71). The progressive staining of teeth that leads them to acquire more brownish shades has multiple reasons that can be linked to the degradation of organic constituents of the dental rigid tissue, the continuous accumulation of external substances in enamel and dentin, characteristics of mineralization, and/or be related to changes in the refractive index, which serves as to measure the optical reflection spectra as a function of the light wavelength and their interpretation with respect to different colors and their intensity(72). The attractiveness exerted by someone's teeth is also connected to the state of wear her/his teeth present, which is 'related to diet, dietary habits and age, whilst shape of teeth and spacing may signal the presence of genetic disorders such as Pfeiffer Syndrome, Robinow's Syndrome and

Rapp-Hodgkin Syndrome (p. 1)(71). Currently, the overall appearance of someone's teeth is increasingly linked to her/his socioeconomic status, demonstrating the inequalities, that is, the social disadvantage and deprivation one undergoes in life, being that, globally, policy makers and public health practitioners focus on developing measures to effectively tackle the emergence of oral diseases, analysing for this multifactorial intervention topics such as 'family income, educational attainment, employment status, housing, physical health, and mental health' (p. 148–9)(73).

A cohort investigation conducted with non-faculty civil servants at a university in Rio de Janeiro (Brazil), that accompanied these participants for a 13-year period, concluded that 'poor social position and weak social ties were important predictors for tooth loss and poor self-rated oral health (SROH)', being that:

A greater social position was linked to more social ties ( $\beta = 0.31$ ), health insurance ( $\beta = 0.48$ ), low psychological distress ( $\beta = 0.07$ ), less smoking ( $\beta = -0.21$ ), more regular dental visiting ( $\beta = 0.30$ ), less tooth loss ( $\beta = -0.44$ ) and better SROH ( $\beta = -0.25$ ) over time. Social position ( $\beta = 0.0005$ ) and social ties ( $\beta = -0.0015$ ) were linked indirectly with psychological distress, smoking and tooth loss. Social position was linked indirectly with social ties, psychological distress and SROH ( $\beta = -0.0071$ ) (abstract)(74).

Furthermore, in observing the association between teeth and socioeconomic status we must also expose 'how in the 18th century teeth were extracted from poor children to be transplanted into the mouths of rich older people – a somewhat gruesome example of social and intergenerational inequalities, and a forerunner to modern dental implants' (p 2406)(75). In this aspect and related to what has already been exposed about thanatological crimes, it cannot be left unsaid that the bodies of men who died in wars were stripped of teeth to be used for making false sets (dentures), and implants. Vuckovic (2019) explains that during the War of the Seventh Coalition, which culminated in the Battle of Waterloo in 1815 near Waterloo in Belgium, looters [surviving soldiers, local residents, and teeth scavengers who came from localities of Great Britain] removed the teeth from ten thousands of dead soldiers (the majority of them young, able-bodied European men, with healthy and white teeth) shipping them back to England in barrels. Vuckovic cites that:

Once in Britain, the teeth would be sorted and boiled. This was the only means of sterilizing

them. Afterwards, a dentist would attempt to compile a set of upper and lower teeth, cut them to shape – usually removing the root part – and affix them onto the ivory dentures. The molar teeth were not too often included in the dentures – they were noticeably difficult to remove and hard to work with (2019, online)(76).

Barnett (2018) contributes to this understanding by demonstrating that John Greenwood, a renowned figure of Enlightenment dentistry and the dentist of the US president George Washington's, used for the designing and the crafting of his sets of dentures materials derived from 'teeth of a dead Russian soldier or an African American slave, ivory from an Indian elephant or an Arctic walrus, and South American gold' (p. 210)(77).

At the same time, it is fundamental to discuss that in a number of ancient cultures, the appearance, conditions, and attractiveness of someone's teeth also symbolised an individual's age and/or developmental stage, concretely showing the passing of status from one stage of life to the next, as an indicator that she/he could have greater responsibilities within her/his society, hence associating the aesthetics of her/his teeth to specific societal roles expected from this individual, as if describing the position a person occupied in a particular setting, signalling also what were considered appropriate role behavior for the different statuses in place. An aspect that is still present in modern societies if we think of the dental modifications currently in use, which are the use of braces for straightening teeth, the placement of porcelain veneers over natural teeth, the covering of dental crowns with gold caps and grills, the bonding of diamonds or other gems to the surface of the tooth, and the procedures to whiten teeth. In this sense, on many cultural, ritual and social occasions different societies performed 'the intentional dental ritual of re-shaping or mutilation' with various simbologies and rites of passage connected to them, as in:

initiation ceremonies, puberty, marriage, entry into the warriors' society, feeding in case of tetanus, to allow more efficient spitting, to improve personal appearance, to mimic the appearance of an animal or just to avoid it, to provide a form of tribal and intra-tribal social class identification, to allow the emission of special linguistic sounds, to improve the masticatory function or apparently to facilitate oral sex (6) or even as a sign of mourning. [Being that] modifying the shape of the teeth can also be a means to achieve self-identity or, on the contrary,

of identification with kinsmen, if it is considered a widely performed practice (p. 4)(78).

According to Russell et al. (2013), in differentiating teeth that were lost or extracted because of dental diseases and/or caries from those removed in ceremonies that acted as rites of passage (which could be performed by having the tooth being knocked out – what leaves behind residual tooth roots – rather than it being pulled), researchers use 7 criteria for this recognition, which are as follows:

(1) No evidence of dental disease, (2) symmetry or near symmetry of tooth loss, (3) repetition of similar pattern of tooth loss in the group, (4) fracture of the labial wall of the alveolar bone, (5) indication that the tooth loss occurred in youth, (6) presence of the practice in neighboring or related groups, and (7) mention of the practice in myths and legends.<sup>5</sup> However, some have criticisms for each of these criteria, contending that a highly irregular pattern of loss contrasts sharply with the highly regular practices of tooth removal documented ethnographically in some African groups (p. 318)(29).

In considering the types of intentional alterations or mutilations that were[are] performed in teeth González et al. (2010) state that they consist of 'breaking, filing, sharpening, inlays [incrustations], crown removal, avulsion, dyeing, colouring, changing position, piercing the teeth, etc. 2,3,4' (p. 77)(79). When the positioning of the teeth is taken into account, the same authors clarify that:

Dental mutilations are generally located on the six teeth in the antero-superior group, though cases have been documented of mutilation on the antero-inferior teeth, as well as on teeth in the premolar set.<sup>3,6,7</sup> Dental mutilations on teeth in the molar set are truly uncommon. No dental mutilations have been documented on deciduous teeth (Ibid., 2010, p. 77).

In analysing the great level of pain and the high risk involved (which can even cause death) in the procedures of intentional dental modification and/or mutilation, we must enquire on the perceived benefit that individuals derived from it, what could respond for the reasons that would inspire them to endure these interventions. Barnes (2010) cites some probable motivations that could have had influenced ethnic groups to subject themselves to these practices, affirming that these involve a complex articulation of manifold meaning, which appeals to the willingness that individuals, as if intuitively, demonstrate to conform to the ideas and narratives divulged by the majority of people

within their societies, exercising cultural conformity, that becomes as if a self-perpetuating behaviour by the objective observation that younger individuals make when analysing the perceptual qualities drawn from the majority of individuals in a group (who precede them in age), that is, identifying their common characteristics as if indicators of the latter being able and fit to survive, and hand down this same possibility of survival to their descendants because these are taken as the traits that constituted those who are 'reproductively successful (Logan and Qirko 1996: 622)' (p. 30)(17). Hence, if dental modifications were performed by those who live and thrive it occurs an estimation of the social and biological rewards that might be associated with them, which inspire the need for its continuation in future generations.

In addition, Barnes (2010, pp. 30–2) points out that these practices may serve as to A) 'maintain tribal identity and group cohesion', allowing, by the assessment of the lack of specific modifications or by the manifestation of different techniques of body alteration, an automatic identification of individual who are migrants or trespassers, B) 'protect one against death', C) make possible one to 'appear more warlike while encountering enemies', as in becoming a sight that is intimidating for them, and D) 'employ signals (usually costly ones) [such as purchasing gold caps and grills, to show that the signaler has access to resources, has a high pain threshold and/or a strong immune system because he/she was able to complete and survive the operation, and/or is courageous] that can be seen by others and that help ensure that one secures rewards, usually a mate [that is, providing at the first sight the initial recognition that he/she is of high-ranking and will be a good person with whom to combine genes]'(17).

### Conclusion

In this writing we have exposed how in varied and sometimes interconnected ways the tooth had stood as an archetypal image, and in virtually the majority of societies throughout history, as a symbol for strength, power, beauty, vigour, weakness, the passing of time, speech, sexual selection, attractiveness, sexual appeal, nourishment, the acquirement of maturity, affection, vengeance, protection, identity, richness or poverty, reproductive capacity, health or disease, courage, pain, transition, competence, cognition, loss, growth, endurance, change.

In this sense, the biology and physiology of the tooth in its characters of transitoriness and/or stability had served not only as to allow individuals to embodiedly experience in themselves these paradoxical lived contrasts, what serve as a practical way to integrate in themselves the veracity of the duality that composes their identities and constitutions, but were also used as to create certain feelings, behaviours, thoughts, and social expectations regarding the socio-historic and cultural identities of the others to whom they related, promoting, hence, certain mechanisms of knowing of self and others, and acting in relation to these 'expectations'.

By observing current societies, we can evaluate how these knowings have a status of being as if a lesson that was passed down and is 'more or less' common and recurrent to all of humanity, for based in phenomena and narratives that transmit powerful experiences – self-worth, the relationship of sons/daughters to their parents, the choice for a romantic mate, death, motherhood, rituals, warfare, religious and/or spiritual experiences –, which are not only logical, but claim for imaginary functions that conjoin personal and impersonal aspects in themselves, and that mainly circumambulate aspects such as: A) the liveness of the individual corporeity, and its constant changeability;

B) the affective charges that base her/his intentionality of relating to others, as an emotional doer and receiver of impressions and significances; and,

C) the encounters that collective of bodies socially had while creating meanings out of the shared experiences they lived through while co-existing in situated localities with the aim of surviving and thriving through periods of scarcity and unpredictable levels of safety, without forgetting to also collectively negotiate with their own process of humanisation, that is, their attempts of articulating and maintaining moral and/or ethical values, building up their specific repertoire of human virtues and vices.

In modern-day societies we can identify more than the plain extinction of this body of knowledge, but their continuity through spontaneous and/or planned modifications, as indeed the knowledge was somehow transformed through cross-personal relationships, different space-time positions, and perhaps even unconscious relationships between individuals, however, in their manifestations, the embodied approximation of the individual to his/her teeth, and the projections

and unconscious interactions he/she creates and produces while having other individuals' teeth in sight, imagination, and/or analysis, still demonstrates at once physical, emotional, and abstract similar qualities that evoke in their observation and experience certain transpersonal dimensions of life. These dimensions involve experiences of connectedness with knowledge considered outside the boundaries of the ego, that is, with modes of knowing arising from connection with levels of reality beyond personal identity, accommodating the felt sense that the notion that the phylogenetic and ontological development of human consciousness can have while relating to a specific phenomenological object - the tooth, distant, enduring effects.

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