Review Article

Anthropology and its relation to orthodontics: Part 2

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Abstract

Orthodontists are working anthropologists. We measure the bones of skull, face, and teeth, and study the relationship of these structures. We should also be interested, then, in learning as much as possible about the origins of human beings and the evolutionary development of our anatomy. This paper is an attempt to describe the orthodontic relevance during the evolution of humans species.

Key words: Anthropology, orthodontics, evolution, review

The first signs of life on earth, evolution of the masticatory complex, and dentistry in the prehistoric era and evolution of humans and its orthodontic relevance

RELEVANCE OF ORTHODONTICS IN THE EVOLUTIONARY PROCESS OF HUMANS

As mentioned in the first part of the article, our evolutionary process has enabled us to understand the development of the masticatory complex and also has forced us to question the events that might give us some insight into the development of various malocclusion traits, relevant to orthodontics. According to Dr. Crutcher the canine C-1 is the constant number in all the dental formula of various primates to humans. The canine has replaced the incisors in the strange aye – aye: Is it possible that the forward mesial growth of the canine is related to palatal impacted canine in some patients? Tarsiers have coniform incisors, are they related to peg laterals? The left and right posterior teeth of old world monkeys are parallel, but hominin arches diverge distally and the canines do not protrude beyond the occlusal plane. This allows for greater lateral excursion and more efficient mastication. As the cranial capacity increased, the temporal bone also increased leading to the expansion of mandible. To maintain efficient occlusion and mastication, changes in maxillary arch also occurred. However, some patients have parallel posterior teeth leading to bilateral cross bite. Is this related to the parallel arches of the old world monkeys? Supernumeries are often found in the premolar region: Is it related to the three premolars found in Tree Shrew, Tarsier, Lemur, and new world monkeys? Are missing third molars related to the marmoset? The skeletal remains of a male hominin found in Italy's Tyrolean Alp's was from late Neolithic age (5200 years) and had midline diastema and missing third molars. These anomalies are only a small observation of our very complex, interweaving existence. But somehow they are our connection not only to the primates and mammals, but to all living beings.[1]

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ORIGIN OF CROWDING

A common denominator today in the most difficult orthodontic problems appears to be a discrepancy between the volume of alveolar bone and tooth mass. In adults, these problems traditionally require longer treatment times in which the orthodontist may have to compromise relationships, esthetics, and stability through either the extraction of teeth or by positioning the teeth outside the confines of their supporting structures. To develop better treatment options, determining whether these discrepancies are tooth-mass excess problem or an alveolar bone deficiency is needed first. Some of the solutions to orthodontic limitations may be found through a better understanding of the causes for the increase in dental crowding and malocclusions in modern society.

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Anthropologists know that even feral monkeys and apes have as much as 30% malocclusion when slight variations of incisor and premolar rotation are included. In primates and ancient people, a small but significant proportion of malocclusions exists caused by inherited anomalies, developmental disturbances, and other known causes. Thus, it is logical that orthodontic textbooks attribute malocclusion to specific causes, such as teratogens, growth disturbances, developmental anomalies, genetic influences (e.g., inherited disproportions between the jaws), genetic admixture of people from many parts of the world, and behaviors (e.g., thumb sucking and tongue thrusting). However, most modern malocclusions are caused by disparity between jaw size and total tooth arch length.[2]

Anthropologists studying skeletons that were excavated along the Nile Valley in Egypt and the Sudan and have demonstrated reductions in the tooth size and changes in the face, including decreased robustness associated with the development of agriculture, but without any increase in the frequency of dental crowding and malocclusion. These analyses suggest that it was not the reduction in tooth wear that increased crowding and malocclusion, but rather the tremendous reduction in the forces of mastication, which produced this extreme tooth wear and the subsequent reduced jaw involvement. Thus, as modern food preparation techniques spread throughout the world, so did dental crowding. It has been hypothesized that dental evolutionary status corresponds to the strong selective pressures posed by developing technology and increased efficiency of food preparation methods attained by any population. This evolutionary trend is well documented on the dental features of both ancient and present-day populations. For example, the coarse and uncooked diet of Mesolithic man probably resulted in large dental structures. The development and increased sophistication of man's technology during the food-producing Neolithic–Chalcolithic stage led to a relaxation of selection pressures resulting in dental reduction. The same evolutionary trend continues among the contemporary populations as well. Brace (1963, 1967)[2] is of the opinion that the people with the smallest teeth in the world are those whose remote ancestors first developed a complex technology, adopted a sedentary life style based on agriculture subsistence, and made pottery for the effective boiling of foodstuffs. A general reduction in the size of jawbones, as a result of changed food habits and life styles, is yet another possible explanation for dental reduction, presuming the available space on the jaw being the main deciding factor for the dental size.[2]

BEGG'S PHILOSOPHY

According to Begg, extensive tooth wear with complete loss of cusps and exposure of dentin is the natural condition for humans; this wear transforms the incisor overbite into an edge-to-edge articulation and interstitial wear reduces the mesiodistal diameters of the teeth so that mesial drift can shorten the tooth arch sufficiently. This enables all the teeth to fit within the jaw. However, the clinicians need to realize that while the degree of occlusal attrition is directly related to the coarseness of the diet (e.g., amount of grit and fiber), the amount of interstitial wear needed to shorten the tooth row is caused by the chewing forces exerted during the mastication of food because this wear is caused by enamel rubbing on enamel as the teeth move up and down in their sockets.[3]

Kaifu *et al.* noted that the virtual absence of dental wear in modern populations fails to explain the increase in malocclusion as Begg contended. However, underdevelopment of the maxillary and mandibular alveolar bone is clearly implicated. The researchers conclude that human teeth are designed to accommodate very heavy wear without impairing oral health; however, given adequate growth of the jaws, normal occlusion can be achieved without heavy wear. The critical conclusion provided for the clinician is that attritional occlusion should not be regarded as a treatment model for contemporary dentistry. In other words, therapies designed for reducing tooth substance, which occurs naturally in ancient and traditional populations, clearly are misdirected. Conversely, following the lead of the functional approach, clinicians should move forward on therapies that would provide expansion of the jaws to the appropriate size to fit the teeth.[2,3]

Another pioneer Dr. Robert Corruccini has put forwarded his work in a book for orthodontists in 1999, he favored the explanation that reduced chewing stress in childhood produced jaws that were too small for the teeth despite the ubiquitous trend in dental size reduction. Because genetic explanations for malocclusion were common, Corruccini reviewed previously published studies from various geographic regions that demonstrated a significant increase in malocclusion when a switch occurred from that of a coarser traditional diet consumed by an older generation to a more refined commercial diet of a younger generation. He documented a clear genetic continuity between the two age groups in populations, such as Americans in rural Kentucky, Punjabi and Bengali Indians, Solomon Islanders, Pima Native Americans, rural and urban African Americans, and Native Australians. Corruccini also documented a clear association of alveolar bone growth with the functional stimulation of chewing forces, that includes measurements of bite-force variation between generations of Eskimos and experimental studies showing changes in mandibular growth of rats and primates between groups consuming hard and soft diets.[4]

Third molar impactions

Humans evolved in a high dental attrition environment. At the same time, excessively large teeth may have been a selective disadvantage to an individual. Mastication of tough foods not only involved wear of the occlusal surfaces, but also movement of each tooth within its alveolus, constrained by the periodontal ligament. This movement of teeth within the dental arch also resulted in wear on the interproximal surfaces. This resulted in reduced tooth diameters in the mesiodistal dimension. Combined with physiological mesial drift, humans would effectively achieve an increasing retromolar space as they age. The delayed eruption of the third molar seems to be an evolutionary adaptation to interproximal wear of the cheek teeth. It seems that the sizes of teeth were selected in the anticipation of the wear and migration of the dental arcade to create sufficient room for the third molars. The recent secular trend in increasing impactions does not seem to be a genetic change in humans. It is, instead, merely a response to a soft food diet. Without interproximal wear of the teeth, simply there is not enough room for third molar. Other factors at work with modern soft diet is dental arch width: Narrower dental arches that result from disuse also contribute to shorter dental arches with less space available distal to second molars.[5]

Clinical implications

Anthropologists believe that increase in dental crowding and malocclusion occurred with the transition from a primitive to modern diet and lifestyle, to the point that Corruccini labeled malocclusion a 'disease of civilization'.[4] The resultant underlying problem from the adaptations to the changes in diet appears to be an alveolar bone deficiency. All dental professionals should consider alveolar bone discrepancies as a leading cause of dental crowding and malocclusion. When indicated, treatment should focus on the development of alveolar bone and dental arches and not the reduction of the tooth structure.

The profile of the face has long been a consideration in art, anatomy, anthropology, and orthodontia, various methods were developed for measuring the face. Measuring human physical characteristics anthropometry was the main research activity of the first anthropologists early in the 1700s. A major focus for the early anthropometrics was the skull. Cranial capacity, jaw structure, the angle of the brow, and other criteria were analyzed in great detail. Although the focus and application of physical anthropology have changed from its early days, anthropometry remains a useful research tool for paleontologists engaged in the search for the origins of the human species. Variations in skeletal shape and bone structure are vital clues to our prehistoric roots.

1. Dutch anthropologist, Petrus Camper, in his classical investigation of the face to the head, published posthumously in 1786, employed as the base a line drawn through the nasal spine and the center of the auditory meatus, and compared it to a plane tangent to the forehead and face. His work is credited as the beginning of modern science of anthropometry.
2. This plane, or 'horizontal' was modified a few years later by Geoffroy de St. Hilaire (1795), who retained the auditory opening for the more posterior point, but changed the anterior one from the nasal spine to the free margin of the incisor teeth.
3. Much later (1862) Broca established the famous alveolao–condylar plane, which, from its general use by French anthropologists, is often called the "French" horizontal.
4. This is the plane established by the International Anthropological Association at a meeting at Frankfort-on-Main, and hence known as the 'Frankfort Horizontal'. The Frankfort Horizontal was first proposed at the meeting of the Craniometric Congress held at Munich in 1877; it was later ratified at the International Congress of Anthropologists at their meeting at Frankfort, in 1884, hence the name.[6]

The story of dentistry: Prehistoric era

- 8,000-9,000 BC – India world's first dentists (9,000 years ago): Mehrgarh represents a highly developed civilization that existed in India (now in Pakistan) until around 9,000 years ago, much older than the Sumer civilization. Mehrgarh is now seen as a precursor to Indus Valley Civilization. In what could be the earliest example of dentistry in the history of mankind, researchers at the University of Missouri, Columbia, discovered that 8,000-9,000 years ago dentists in ancient India had developed technology to drill teeth and remove decay. This was found on the biting surface of male molars.[7]
- 5,000 BC – A Sumerian text of this date describes 'tooth worms' as cause of dental decay. Evidence of this believes has been found in ancient India, Egypt, Japan and China.
- 2,600 BC – Evidence of a physician and dentist 'Hesy – Re' of Egypt has been found during this era.
- 1,800 BC – In the code of Hammurabai, dental extraction has been referred twice as is related to punishment.
- 500-300 BC – writings of Aristotle and Hippocrates

say about extracting teeth, treating gum diseases, eruption pattern of teeth and holding loose teeth with wires and fractured jaw 100 BC – Celsus, a Roman medical writer, writes extensively in his compendium on medicine about oral hygiene, stabilization of loose teeth, treatments of tooth ache, teething pain and fractured jaws.
- 166-201 AD – The Etruscans practice fixed prosthetics using gold crowns and fixed bridgework.[8]

CONCLUSION

To study and analyze the evolution of human race and its relation to orthodontics is very important. Orthodontics as a specialty has soared to greater heights over a period of time with newer techniques and appliances to correct malocclusion, but the reason of what has lead to the cause of various malocclusion is needed to be analyzed. The advances in dentistry soar to greater heights in the middle ages, Renaissance period, eighteenth century, nineteenth century, twentieth century, and twenty-first century, but has not been included in this study.

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