Review Article

# Anthropology and it's relation to orthodontics: Part 1

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**Abstract**

This paper describes the existence of man on this planet from a single-celled primitive creature to the multi-celled, highly specialized being that we are. More importantly, this article gives a description of the evolution of human dentition, temporomanibular joint and masticatory complex, and, in course of time, how the evolution has had its relevance in orthodontics.

**Key words:** Anthropology, evolution, orthodontics

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

## INTRODUCTION

Charles Darwin was a close observer of nature. His theory of evolution grew from watching an undisturbed patch in his garden. He plotted the 2-by-3-foot area and carefully recorded every wild sprout of grass and weed. He followed the fate of each individual organism and continued his study for years. The human masticatory system, which consists of the maxilla, mandible, teeth, temporomandibular joint and the masticatory muscles, is functionally involved in not only feeding but also in speech. Just like all other anatomical features of our species, the masticatory system has also evolved during the history of evolution of man.[1]

To understand the evolution of man, we must have a thorough knowledge about the stages of the geological time scale used for the anthropological studies.



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### Geological time scale in millions of years[2]

Geologic time is divided into a four-level hierarchy of time intervals:
EONS: The first and largest division of geologic time.

ERAS: The second division of geologic time; each era has at least two periods.

PERIODS: The third division of geologic time. Periods are named for either *location* or *characteristics* of the defining rock formations.

EPOCHS: The fourth division of geologic time; represents the subdivisions of a period.

There are 4 Eons: Pre-Archeon or Hadean, Archean, Proterozoic and Phanerozoic.

*Pre-Archeon Eon* (4.6-3.8 billion years), 4.6 BYA – Oxygen, a chemical compound crucial to many forms of life on Earth, started on the Earth in miniscule quantities but began to grow, as, for instance, it reacted with iron to produce rust particles. When there was no more iron left to react with, oxygen began to build up in the atmosphere. The stage was set for the evolution of oxygen-breathing animals.[3]

## THE FIRST LIFE

Archean Eon (3.8-2.5 million), 3.5 BYA – Oldest known fossils record the existence of single-celled organisms resembling bacteria; 3.2 BYA – First known plants (algae) are formed.[1] The first origins of life were likely small, simple and not diversified. It is believed

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that heterotrophs were the first beginnings of life on Earth, inhabiting the sea and absorbing the organic material that was being created by the reactions of Earth at the time (i.e., the creation of amino acids). The heterotrophs were absorbing carbon and light and, after the biological reactions responsible for creating energy in them, oxygen would be released as a by-product. Oxygen began to accumulate in the oceans, leading to the creation of aerobic organisms, who used oxygen as a component of their energy creation.[3]

Proterozoic Eon (2.5-5.7 million): The eon of the first multi-celled life. 1.2 BYA – First known animal (jellyfish) (end of the precambrian – It is a period at least five times longer than all the geologic times that follow).[2]

*The time before the phanerozoic era is collectively called "Precambrian." It is not included on many geologic timescale charts because of the scarcity of life forms before the Cambrian Explosion.*[2]

### Phanerozoic Eon: 570 million to present

*Paleozoic Era* (570-245 million years). The era of ocean life; land animals appear toward the end of this era.

Cambrian period (570-505 million years). Onset marked by the appearance of the first shellfish and corals; sometimes called the "age of marine invertebrates."[2] This was the beginning of cell specialisation into tissues, where particular tissues could perform functions for the well-being of the organism at large. Just like all other organisms developing in the Cambrian era, the echinoderms were of a simple nature; a classic example is the Starfish, which has stood the test of time via the Cambrian Era to todays' world half a billion years later. Worms were some of the first diversifying animals to be found on Earth in this era. The first hard-shelled organisms (such as trilobites) proliferated in this era. The end of the cambrian period is denoted by the appearance of fish.[3]

Ordovician period (505-438 million years): The fish first appeared in the fossil record; these were the first vertebrates.

Silurian period (438-404 million years): Appearance of the first land plants.[3]

Devonian period (404-360 million years): The first insects (anthropods) and first amphibians (tetrapods) appear.[2]

### Carboniferous period

*Mississipian epoch* (360-320 million years): Abundant amphibians and the appearance of the first reptiles.[2]

*Pennsylvanian epoch* (320-286 million years): The first mammal-like reptiles evolved.[3]

Permian period (280 million years): Reptiles enlarge and diversify.

*Mesozoic Era* (245-65 million years): The era of reptiles, sometimes called the "Age of the dinosaurs."

Trassic period (245-208 million years): First appearance of dinosaurs in the fossil record.[3]

Jurassic period (208-145 million years): First appearance of mammals (around 222 MYA); dominance of the dinosaurs; 150 million years – This period marks the first appearance of birds.[2]

Cretaceous period (145-65 million years): Flowering plants appear and spread rapidly; there was continued increase in dinosaurs. Dinosaurs, the Greek word meaning *terrible lizard*, were the most advanced reptiles of all time. It is thought that the original dinosaurs were of a very similar nature to that of the early reptiles. The dinosaurs disappeared around 65 million years ago, with many other land-dwelling organisms also dying out around this time. The general consensus is that a major geological event killed off many of the land-dwelling organisms, particularly the larger ones. As the dinosaurs were extinct, true mammals were beginning to develop, exhibiting many of the characteristics you would see in any present day mammal.[3]

*Cenozoic Era* (65 million years to the present): The era of mammals.

*Tertiary period* (65-1.6 million years).

Paleocene Epoch (65-58 million years): Appearance of mammals.

Eocene Epoch (58-37 million years): Horses (around 53 MYA), whales and monkeys first appear in the fossil record.[2]

Olegocene Epoch (37-24 million years): Elephants and apes first appear in the fossil record.

Milocene Epoch (24-5 million years): Hominids first appear in the fossil record.

Pilocene Epoch (5-1.6 million years), 2 MYA – First human-like animals.

*Quaternary Period* (1.6 million years to present).

Pleistocene Epoch (1.6-0,000 years): The modern ice age; first modern humans appear.

Holocene Epoch (10,000 years to present day): Began with the end of most glaciations.

## EVOLUTION OF THE TEMPOROMANDIBULAR JOINT

Because dental occlusion has to do with teeth, and teeth are set on or in the jaws, and because jaws are a part of the general skeleton, it is evident that we must know about the evolution of the temporomandibular joint before the evolution of teeth.[4]

All the occlusal relations of human teeth are dependent upon their being set in a fixed upper and a movable lower jaw, the latter moving mostly up and down and also somewhat obliquely. We may also have an occlusal relation between teeth or tooth-like projections set on either side of the symphysial end of two half jaws, which may rotate on their long axes more or less independently of each other. Such an arrangement is seen in the jaws of the Devonian arthrodiran fish Diplognathus and in those of certain Characin fishes; among mammals, in the Yak, there is considerable independent movement of the right and left halves of the mandible at the symphysis. These "teeth" are evidently hinge teeth.[4]

There is considerable evidence that in vertebrates, the jaws originated in the walls of the oralo–branchial chamber. The jaws of the ancestors of vertebrates were "food sifters" and lived upon minute living particles, which were drawn in the mouth probably at first by the action by cilia. With far reaching discoveries about chordates, it has been found out that in Ostracoderms (the oldest known vertebrates of the Ordovician and Silurian ages), the cavity of the mouth was in series with those of the primitive gill pouches and that the floor of the mouth could be moved up and down like that of a frog. The Ostracoderms jaws already showed the beginning of a pincer-like construction of the later vertebrate jaws. In spite of the occasional presence of functional mandibles, the Ostracoderms together with their highly specialized descendents, the lempreys and hagfishes (cyclostomata), were classed as "Agnathi," meaning jawless, because they did not possess internal jaws like the shark. In the shark, the underlying oro–branchial arch became enlarged into a great fish trap while the surface layers of the dermal plates disintegrated into shark teeth that rested on "cartilage jaws."[4]

The line of ascent from air-breathing fishes to land-living quadrupeds occurred in the Devonian age. In the lobe–finned fish, air-breathing fishes of the Devonian and later periods as well as in the ganoid and teleost fishes, both the upper and the lower jaws were of a complex type, consisting of an inner core corresponding respectively with Meckel's cartilage and palatoquadrate in the upper and covered by a number of bony plates, some of which bore teeth.[4]

In the early amphibians, the dentary bone of the lower jaw was the largest of the eight surface plates on each half of the mandible. In the upper jaw, the premaxilla and the maxilla were much smaller than the bones above and behind them. In the primitive amphibian, the stem reptile and the mammal-like reptiles, the dentary bone and the maxilla greatly increased in size until, in the earlier adult mammals, the dentary has become the sole bone of each half of the lower jaw and the premaxilla and maxilla together formed the entire subocular surface of the face. In primitive amphibians, a bone called the hyomandibula helped to brace the upper jaw against the skull (the suspension-system in all animals is called the suspensorium). The transition from this stage to that of man chiefly involved deepening and antero–posterior shortening of these elements.[4]

During the Triassic, the mammal-like reptiles declined and, by the Upper Triassic, they had been replaced as the dominant group of land animals by the dinosaurs. But, by the Upper Triassic, one or more of the groups of mammal-like reptiles had crossed the boundary between reptile and mammal, so that we know two groups of mammals in the Upper Triassic. One group, exemplified by *Kuehneotherium*,is the ancestor of almost all living animals; the other, exemplified by *Morganucodon*, has as possible living descendants only the monotremes-the duck-billed platypus and echidna of the Australian region. The carnivorous mammal-like reptiles did not in fact shear up their prey as do modem carnivorous and insectivorous mammals or as did *Morganucodon* and *Kuehneotherium*. In such a shearing bite, the food being cut forms a wedge that tends to force the teeth apart. This is prevented by the action of the masticatory muscles holding the teeth in active occlusion. Thus, only the cheek teeth on one side of the jaw can be effective at any one time, and each side has alternate periods of activity and rest. This process may be seen readily by watching a cat eat. But, the shearing bite also applies a twisting motion to the whole jaw, tending to dislocate the articulation. This is why the glenoid in modern carnivores extends well laterally and has a backwardly directed process at its lateral end. This last process is a thrust-bearing process to resist the forces trying to dislocate the condyle by rotating it in the horizontal plane. The shrew has a double condyle on the dentary for similar reasons. Relative to the size of the animal, the accessory jaw bones are as large in the *Morganucodon* as in one of the later, carnivorous cynodonts such as *Cynognathus*, and, like the cynodont, the mammal has a strong joint between articular and quadrate. This reptilian joint, however, was directly in the line of the tooth row and was not able to resist the twisting movement at the hinge produced by the shearing action of the teeth. To resist this, a second articulation was formed by a condyle on the end of the dentary working in the glenoid facet on the squamosal. The effect of this was to extend the articulation well lateral to the tooth row thus enabling it to resist the forces at the hinge tending to dislocate the jaw. The primary reason for the evolution of the temporomandibular joint must have been to enable the jaw articulation to resist the forces produced by the shearing dentition.[5]

The mammal-like reptiles had a jaw joint that consisted of two bones called quadrate–articular joint or palate–quadrate joint. Further in the evolution process, the progressive enlargement of the ramus extended postero–dorsally and its lower corner came close to the squamosal bone of the temporal region but it did not form contact with that element by a cushion, a bursa or meniscus derived from the temporal muscle in which it was embedded. In mammals, further emphasis of this tendency led to the formation of the "temporomandibular joint." As it was formed, the old joint at the posterior end of the jaw, between the articular portion of the Meckel's cartilage and the quadrate portion of the palate–quadrate, or primary upper jaw became greatly reduced in size and was finally transformed into the malleo–incudal joint of the auditory osssicles. In mammals, the quadrate–articular joint was replaced by another two-boned jaw joint called the dentary–squamosal joint or mandibular–temporal joint. These still exist in mammals but are not part of the jaw articulation at all; they have passed into the middle ear and form the incus and the malleus, two bones of the chain of three in the middle ear (the other is the stapes) that transmit sound from the drum to the fenestra vestibuli and, therefore, to the inner ear. This temporomandibular joint along with the jaw musculature determines all the many occlusions to be found in mammals.[4]

When the evolution of the mandibular condyle was evaluated, it was shown that the early hominins inherited a low and anteriorly placed joint from some ramamorph ancestor with a similarly placed joint point. In the ausralopithecine line, the joint remained forward but was raised. In the *H. erectus* group, it was raised less and displaced backward. Neanderthals had a high ramus width, but they had widely different values of ramus height.

In Homosapiens, the joint has moved forward, but it has maintained the same distribution of elevations as that for the Neanderthals. The mandibular condyles of the hominins occupy a restricted position in relation to the occlusal plane. Different positions (high, low, forward and backward) have a considerable effect on the movements of the lower molars when the jaws are closed and thereby affect the way in which food is processed during mastication. During human evolution, there have been fairly well-defined changes in the position of the temporomandibular joint, which were probably related to changes in food processing and diet.[6]

### Evolution of teeth

The earliest known fishes, the *Acanthodians*, which are older than the shark, had denticles that were loosely attached on or near the surface of the lower jaw. In the air breathing, lobe finned fish of the Mesozoic times, two classes of denticles were present. One class comprised a row of small teeth on the margins and a few much larger sabre-like tusks forming a widely spaced inner row on the roof of the mouth and inner sides of the lower jaw. This labyrinthodont type of attachment was transmitted to the earlier amphibians. By the time of the early reptiles, the pits in which the **labyrinthodont teeth were sunk at the base gradually changed into sockets.** These simple socketed teeth were arranged in a scissor-like pattern. As the teeth were at a distance from the fulcrum or quadrate–articular joint, their moments of inertia differed accordingly and thus they already exhibited an early stage in the **differentiated into incisors, canines, premolars and molars. The differentiation further carried into the formation of huge canines.** In these higher mammalian reptiles saw, **reduplication of cusps** was noted, such that in relation to the main cusp, there was presence of **small basal accessory cusps.**[4]

The mammal-like reptiles were present at around 280 million years ago. The early ones were the

Polycosauria, comprising of carnivorous, piscivorous and herbivorous forms. The specialization of teeth and masticatory apparatus is such in the herbivorous type that their capacity for further evolution is limited and major evolutionary changes are always initiated by the carnivorous and insectivorous forms. In the Dimetrodon (carnivorous pelycosaurs), the function of the dentition was to seize and kill the prey. Toward the anterior end of the maxilla, there was a pair of teeth that was the largest in the jaw; these teeth could be called canines, the teeth mesial to these were the incisors and the teeth distal to these teeth were the cheek teeth. Thus, the functional differentiation of the teeth into incisors, canines and cheek teeth had already taken place as early as lower Permianas mentioned above. Another striking feature of "tooth replacement" was seen in mammal-like reptiles, which is also a feature of all mammals.[5]

The forerunners and collateral relatives of the mammals were diversified by very small jaws and teeth of the Jurassic period. Two main divisions of the teeth were: (a) Triconodonta, in which the crown of each cheek tooth was compressed and bore three cusps in the anteroposterior line. The three-cusped triconodont cheek teeth became the forerunner for trituberculer molar; this became the ground plan for the later mammalian type. (b) Symmetrodonts, in which the cheek teeth formed compressed blades, which were placed alternately in the upper and in the lower jaws. The above facts do indicate that in the Jurassic period, Triassic period, Cretaceous period and Tertiary period, profound differences were found in the diameter of the teeth and also that the upper tooth row as a whole overhangs the lower thus explaining the fact that the triad of the lower cheek teeth cusps fit into interdental embrasures between the upper molars.[4]

In *Deltatheridium pretrituberculare* of the Cretaceous period, the cheek teeth were reduced to three. The upper cheek teeth crowns were widely triangular. The lower molars were small as compared with the uppers and their sharp trigonids fit into the interdental embrasures and shear past the blades of the upper cheek teeth. The distobuccal cusp (metacone) was barely separated from the mesiobuccal cusp (paracone). The upper cheek teeth had increased mesio–distal diameter and thus narrow interdental embrasures, which were less than the Deltatheridium. The metacone and paracone were distinctly separated and the hypoconid – the outer buccal cusp – became large and occluded with the lingual cusps of the lower molars. Further down the evolution line, the upper cheek teeth were arranged in a convex curve and the lower cheek teeth were arranged in a concave curve, resembling a curve of spee.[4]

Note: Cheek teeth (cannot use the term "molars" and "premolars" as these terms in mammals are defined in terms of tooth replacement).[5]

### From primates to apes

Fossil evidence has uncovered a very old, very small, warm-blooded creature called megazostrodon. It is the oldest known mammal. Geological dating places it on Earth at 200 million years ago. Tree shrews, the most primitive of all mammals, are an arboreal variation of the megazostrodon. They had teeth that were generally more cone shaped than other primates. The basic building blocks for all mammalian teeth are these cones, from which all the teeth have evolved.[1]

Among the more primitive characters of the oldest known lemuroid primates was the triangular form of upper cheek teeth, fitting of trigonids into the interdental, the upper cheek teeth cusps became less sharp and the postero–internal corner filled out; as this happened, the antero–internal cusp, or the paraconid, disappeared from the lower cheek teeth and the talonids became more prominent. Here lay the foundation of the end-to-end relation of the upper and lower molars. The upper central incisors were separated by midline diastema.[4]

A strange lemur genus is the aye–aye; they do not have incisors while the upper and lower canines are inclined labially. The teeth erupt throughout the life time thus maintaining their length. The upper canines form in the maxilla rather than in the premaxilla. The next species in the primate evolution is the tarsier, which has a combination of primitive and advanced features. There are many who believe that these genera evolved the branch leading to modern great apes and to man. They have coniform incisors. All primates present three premolars.[1]

In the branch of primates to which man belongs, namely the Catarrhinae, including the old world monkeys, apes and man, there was a tendency for the two outer cusps of the upper molars to develop transverse ridges and for the lower molars to develop transverse crests. The dental formula for old world monkeys is upper and lower I – 2, C – 1, *P* – 2, M – 3. This is the same as that for great apes and hominids. New world monkeys are almost completely arboreal and the dental formula for them is I – 2, C – 1, *P* – 3, M – 3. All the above primates do not have clavicles and, therefore, they cannot branchiate. They have a tail for balancing in running and leaping. The incisors were large and were procumbent when first erupted. The canines were sexually dimorphic; males had more projected canines than females. The smallest living monkey is the marmoset, and it has three molars.[1]

### The great apes: Gorilla, gibbon, orangutan and chimpanzee

The gorilla is the largest of the four great apes. The gorilla is vegetarian, which is reflected in its large grinding molars, especially the lowers. The dental formula is the same as the old world monkeys and the hominids. There is presence of diastema between laterals and canines. The gorillas have clavicles, which are very important for branchiating. Gibbons are the next in the evolutionary line. The premolars of the gibbons are bicuspids, but the cusps are mesial and distal, rather than bucco–lingual. The orangutans are arboreal; the dental formula is the same as for the gorilla, except that the jaws are narrower. The chimpanzees are both arboreal and terrestrial. The dental formula is the same as that of the orangutans, except that the dental arch is a little wider. Comparing the chromosomes of the great apes with that of Homosapiens, the chimpanzee is the closest match![1]

In the Dryopethicus of Europe and in a more related generae, Sivapithecus and its allies in India, there was evidence of retrogressive changes in the anthropoid molar crowns. The discoveries in the last century of the fossil apes (Dryopithecinae), Ape – man (Austrlopithecinae) and men have brought forward much evidence that the five-cusped Dryopithecus molar gave rise to various molar pattern of anthropoid apes and also to the retrogressive four-cusp pattern of human molars.[7]

In the later evolutionary changes, the dental arch became shorter and wider. The size of the incisors and canines reduced, the lower premolar crown was transformed from an obliquely oval to a more nearly symmetrical crown and the third lower molars originally larger than the first molars were reduced in size and were ultimately eliminated. The upper and lower molars became the dominant cheek tooth.[4]

### The early hominin (hominid)

It was suggested in early studies that the human ancestral line involves the hominid family, which diversified from the apes around 6-8 million years ago. During the Miocene epoch, the family Hominoidea diverged into two sub-families: The Pongidae (apes) and the Hominidae (humans). In general, Dryopithecus is considered to be the ancestor of both apes and humans. The Darwin theory suggests that there are four features that distinguish humans from African apes: Bipedalism, tool use, canine reduction and the expansion of brain. However, further research suggests that the term "Hominid" is no longer applicable in defining the ancestory of humans, as the human line separated from the rest of the "Hominids" about 6-8 million years ago; this refers to the ancestory of the living African apes and all its descendents. The correct term to describe an ancestor of the human race is "Hominin."[6]

*Dryopithecus*: This genus lived in Africa, China, India and Europe. The genetic title Dryopithecus means oak wood apes, because it is believed that the environmental conditions were such at that time, with densely forested tropical lowlands, and the members might have been predominantly herbivorous.

*Ramapithecus*: The first remains of Ramapithecus were discovered from the Shivalik hills in Punjab and were later discovered in Africa and Saudi Arabia. The region where Ramapithecines lived was not merely forests but open grasslands. A hominid status for them is claimed on two grounds: (i) Fossil evidence indicating adaptation, including robust jaws, thickened tooth enamel and shorter canines and (ii) extrapolation regarding upright posture and the use of hands for food and defence.

*Australopithecus*: This genus is the immediate forerunner of the genus Homo. The first Australopithecine find was made in 1924 at Taung, a limestone quarry site in South Africa, by Raymond Dart. They walked erect, lived on the ground and probably used stones as weapons to hunt small animals. They weighed 60-90 pounds and were about 4 feet tall.

The skeletal remains of man in the early Pleistocene period were found and named as Heidelberg Man. His skeletal remains — the famous Heidelberg jaw — consisted of a massive fossilized chinless jaw with distinctly human dentition. The specimen was discovered in 1907 near the town of the same name. *Homo neanderthalensis* (Neanderthal Man) is known as the pre-modern man and is well known for its hypothesised common ancestry with man. They arrived on the scene around a quarter of a million years ago. The name is derived from a valley in western Germany where the skeletal remains were found in 1856. He was distinguished by a stocky, heavily muscled build, proportionately short forearm and lower leg and an extremely dolichocephalic skull with projecting occiput, heavy supraorbital tori, receding forehead and underdeveloped chin. Next in the ancestral line of man is *pithecanthropus*, a primitive man who is known from a skull and other bone fragments found near the village of Trinil, Java, in 1890. The profile is similar to that of the ape, with a very low forehead and an undeveloped chin. The teeth are characteristically like those of human beings. Another link is the *sinjanthropus*, whose skeletal remains were discovered near Peking, China, in 1929, and is also known as Peking Man. Skulls, many teeth and other skeletal parts reveal a close anatomic relationship to pithecanthropus. It is considered "close to the main line of descent to modern man." It was not until the postglacial period, which extended back 30,000 to 40,000 years, that modern man, ***homo sapiens***, appeared. The Cro-Magnon Man is an outstanding representative of the first "true man." Many of his skeletal remains have been found in various parts of Europe. The name is derived from a cave near Les Eyzies, France. The shape of the skull, face and brain are characteristic of the modern Caucasian man, except for the difference in size. During the years from prehistoric time, man has undergone certain evolutionary changes.[8]

The change from arboreal to terrestrial life of our ancestors could not have occurred without a change in their anatomy. Another reasonable explanation would be the climatic change. Tropical forests gave way to isolated forested areas with brush and grass, but eventually Savanna lands predominated where once forests prevailed. Forests gradually became extinct due to which the arboreal primates perished; those who survived (like the ones discussed above) became terrestrial. Being grounded, the ability to stand up and see the surrounding vegetation and suspect danger became an advantage. Upright locomotion freed the hands for balancing and carrying tools and offsprings.[1]

Those individuals with feet closer could walk or run thus eliminating the swaggering of the great apes. New type of food was required as leaves, nuts or fruits were no longer readily available; thus, the hominin became an omnivore. As structural changes occurred in the skeleton, the skull also adapted accordingly. The forward stance of an arboreal existence required strong muscles on the back of the neck and shoulders, which attached to three nuchal ridges on the top of the back of the skull. With the weight of the head now resting on the spinal column, the foramen magnum shifted from the posterior to the inferior of the skull. The strong nuchal muscles reduced and their articulating surfaces, the nuchal rigdges, migrated down the back of the head. Early hominins had robust zygomatic arches and glabellum and strong masticatory muscles. These further formed a strong restraining muscular cap. As they retreated to the inferior of the skull, the cranium expanded, allowing increased cranial capacity and development of forebrain.[1]

### Evolution of the curve of spee

As discussed earlier in the paper, the development of the curve of spee had already taken place in the early mammals of the lower Permian period. The occlusal plane in humans is often not horizontal. A helicoidal occlusal plane is an inclination of the teeth where the anterior cheek teeth show a plane sloping upward palatally while the more posterior teeth have a plane sloping upward buccally forming a twisted occlusal plane. Even though the helicoidal occlusal pattern has been regarded as a feature typical for the orofacial region of Homo, it is also seen in the plio–Pleistocene hominids and in non-human primates, especially in the chimpanzees. It has been stated that the foreshortening of the dental arcade in hominids resulted in molars coming to lie mostly posterior to the root of the zygomatic arch and medially to the Masseter–pterygoid complex, and both factors appeared to be important for the development of the helicoidal occlusal plane. Also, the reduction of the dental arches and their retraction under the cranium required axial inclination of the molar roots. It has been proposed that this axial inclination of the teeth in the course of evolution has been paralleled by differential changes in cusp heights in order to keep the masticatory complex functional. The posterior teeth of the humans are also inclined in the sagittal plane. Human lower third molars have undergone a forward tilt during the course of evolution as a result of the displacement of the temporomandibular joint in relation to the occlusal plane. This developed the curve of spee, which is more pronounced in humans when compared with the other hominins. This also rendered the third molars functional despite their disadvantageous position. It has been stated that, because of this curve, molars on the working side function in a smooth grinding movement.[6]

### Evolution of the chin button

The protruding chin is one of the evolutionary features that separates homosapiens from our ancestors. Upright posture in hominin exposed the jugular notch – the vulnerable spot above the sternum and between the clavicles. The forward stance of the primates hid this vital spot and, when necessary, both males and females used ferocious upper canines to defend it! Losing those advantages, hominins developed a chin button, which nicely defends the jugular notch when the head is ducked. Males had prominent chin buttons as compared with females. Man and elephant are the only mammals with chin buttons. The hominin chin button allows for attachment of orbicularis oris, the ring of musculature that restrains protrusion. Many studies have suggested various reasons for the development of the chin, such as the masticatory system-related biomechanical forces were believed to play a role in the formation of the human chin. Chim *et al.* have claimed that a study of those selected for having untreated excellent occlusions finds that for each millimeter of chin button, there is a 4 mm reduction of the distance from the labial of the incisor to the facial plane.[1,6]

### Evolution of speech

Appearance of spoken complex language is believed to be the result of the critical change in the human evolution that occurred 40,000 years ago, named "the great leap forward," which resulted in the formation and development of human civilization. It has been claimed that the formation of the anatomic basis for the complex speech was the cause of this leap. Speech and language need a flexible oral system. This flexibility is maintained by providing processed and softened food, which does not require a strong musculoskeletal build and sharp teeth. It was stated that the human oropharyngeal system differed from other mammals for having communication as a dominant function. It was further reported that the supralaryngeal airway of humans was different from other mammals, with food following the same path as the air, which increased the risk of airway obstruction while eating by the falling of food into the larynx. It is also stated that the chewing activity of humans was less efficient when compared with that of the other mammals and archaic hominids because of the reduced size of the palate and the mandible, and that the evolution of the maxillo–mandibular system was closely related to the development of brain, by stressing that language provides communication and coordination between the individuals and also plays an important role in "thinking" for humans in their native language. It has been hypothesized previously that a larger cranial vault for a larger brain is maintained by the decrease in the size of the mouth. It has also been stated that bipedal posture required a smaller mouth for the arrangement of the center of gravity of the human cranium. Even though most primates, together with some hominins like the australopithecines, have powerful masticatory muscles, members of homosapiens tend to have smaller masticatory muscles. It has been stated that the masticatory apparatus of the hominin clade shifted toward gracilization accompanied by accelerated encephalization in early homosapiens. Stedman *et al.*[9] have claimed that a gene encoding the predominant myosin heavy chain expressed in the masticatory muscles was inactivated by a mutation at the time of divergence between humans and chimpanzees. They have dated this mutation back to 2. 4 Ma, predating the appearance of modern human body size and emigration of Homo from Africa. The loss of this protein isoform resulted in size reductions in the muscle fibers and entire masticatory muscles. It is believed that the cranial capacity increases as a result of this weakening of the muscles, relaxing the pressure on the sutures, leading to larger encephalization. The anatomical changes necessary for the formation of language also have some drawbacks. The evolutionary changes for speech result in pharyngeal collapse, which is believed to be the cause of obstructive sleep apnea. Davidson has proposed that the supralaryngeal vocal chord tract (SVT) has been modified to form a 1:1 ratio between the horizontal and the vertical segments. The horizontal dimension of the SVT has decreased by the shortening of the midface and lengthening of the vertical SVT by the descent of the larynx, for this purpose. These changes in the SVT were accompanied by a narrowed, elongated distensible pharynx and posterior displacement of the tongue from the oral cavity into the pharynx. He has stated that speech is formed by the coordination in the functions of the oropharynx, tongue, teeth and lips.[6,10]

## CONCLUSION

The evolution of the human masticatory complex is strongly related to diet, use of tools and fire and, finally, speech. From 30,000 years ago up until this present day, our own species has exhibited the most advantageous characteristics to adapt and manipulate our environment. The skills accumulated over many generations of our species and continued favoring of advantageous characteristics via natural selection inevitably meant that our species would evolve beyond all recognition in comparison with the other species of the planet. From this point, the species and its component skills managed to colonize all the main continents of todays world. However, more complex tools were being developed, and this has continued over the period of time where we have successfully monitored historical events in our human race.

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