Dog Teeth for Dog Lovers
by Thomas Tyler Skrentny, M.D.

I. General Remarks:

A. The zoological classifications of the dog is as follows:

Kingdom	-	Animalia
Phylum	-	Chordata
Sub-Phylum	-	Vertebrata
Class	-	Mammalia
Order	-	Carnivora
Family	-	Canidae
Genus	-	Canis
Species	-	Familiaris
Sub-Species	-	Dolichocephalic (long-headed)
Race	-	Doberman

B. There are 14 Genera comprised of 35 species in the Family Canidae. All but three of these Genera have the same dental formula. There are three incisors, one canine, four premolars in the upper and lower jaws, right and left sides. There are two molars on each side of the upper jaw, and three molars on either side of the lower jaw.

This is variously written as 3/3. 1/1, 4/4, 2/3 or as $\frac{3142}{3143}$; or as

left $\frac{2\ 4\ 1\ 3\ 3\ 1\ 4\ 2}{3\ 4\ 1\ 3\ 3\ 1\ 4\ 3}$ right; or as left $\frac{2M\ 4P\ C\ 3I\ 3I\ C\ 4P\ 2M}{3M\ 4P\ C\ 3I\ 3I\ C\ 4P\ 3M}$ right.

All these numerical sequences say the same thing. The dog has 42 adult, or permanent teeth, and does not differ in this respect among the other species of the Genus Canis, which are closely related to him, such as, the fox, wolf, coyote, or jackal.

C. When a dog is a puppy, he has a first set of teeth called the primary, baby, milk, or deciduous (shed) teeth. These teeth are unrelated to the permanent teeth. Their presence or absence does in no way affect the presence or absence, growth or development of the permanent teeth.

There are 28 milk teeth. Three incisors, one canine, two premolars and one molar found on each side of both the upper and lower jaw. (Some authorities call all the premolars and molars "deciduous molars", others call them all "deciduous premolars." I prefer to call the first two premolars and the last one a molar because of their resemblance to the permanent premolars and molars.)

The dental formula for milk teeth is: left $\frac{1M\ 2P\ C\ 3I\ 3I\ 2P\ 1M}{1M\ 2P\ C\ 3I\ 3I\ 2P\ 1M}$ right

II. Talking about Teeth:

For those readers who have survived section I, I will now explain the different methods that have been used to code teeth. It is cumbersome to keep referring to the left or right, or the upper or lower teeth. Therefore some short-hand codes have been developed to simplify this problem. Some authors have used sub- and supra-scripts. In this code the first premolar in the upper jaw would be written P^1; whereas the first premolar in the lower jaw would be P_1. When describing the deciduous teeth, this code places the small "d" before the P^1. Thus the first deciduous premolar in the upper jaw would be written d P^1. And etc.

The code used by Bodingbauer and others, and the one which will be used in this article, is as follows: All teeth are given a number, beginning at the central incisor and counting back to the molars on both sides of each jaw. Thus the expanded dental formula for the teeth becomes:

left 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 9 10 right
11 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 9 10 11

1, 2, & 3 are the incisors; 4 is the canine; 5, 6, 7, & 8 are the premolars; 9, 10, & 11 are the molars.

The first premolar in the upper jaw is 5 in this code; whereas the first premolar in the lower jaw $\overline{5}$. A line below the number tells that the tooth is in the upper jaw. A line above the number tells that the tooth is in the lower jaw. If it is on the right side of the upper or lower jaw, then a line is drawn on the right side of the number. Conversely if the tooth is located on the left side, then a line is drawn on the left side of the number. Therefore, the first, right upper premolar is: 5⌋, the first premolar on the lower left would be written as ⌈$\overline{5}$.

If one wishes to refer to both first upper premolars, then he either writes a line on each side, or no line at all (both methods are used interchangeably): 5 or ⌊5⌋.

A line above and below the number means the same tooth in the upper and lower jaw; a line on the left limits it to the left side; a line on the right limits it to the right side; such as: ⌈$\overline{6}$ or $\overline{6}$⌋. No side-lines or two side lines refers to the same tooth both sides of both jaws: $\overline{6}$ or ⌈$\overline{6}$⌋.

The milk teeth are drawn similarly except that Roman numerals are used. The expanded dental formula for milk teeth is:

left VII VI V IV III II I I II III IV V VI VII right
VII VI V IV III II I I II III IV V VI VII

The first deciduous premolar in the right upper jaw is V⌋. Etc.

III. What is a Tooth?

All teeth regardless of their shape are composed of the same basic materials. On the top, showing above the gum line, is the crown or cap. It is composed of long hexagonal rods of crystalline material, composed primarily of calcium, oxygen, phosporous, chlorine, carbon, and florine. These rods are extremely hard, giving off sparks when struck with steel. They are glued together by a substance called cementum. The cementum plus the rods are called enamal. (In the decaying process this crystalline material is lost.)

The crown is formed by special cells of the embryo called ectoderm. The ectoderm also gives rise to the skin, hair, nervous system, and sensory organs. Defects of the crown are frequently associated with defects of these other structures.

Beneath the crown is the dentin. This tough material is not as hard as enamel, being more or less identical to bone. Unlike the enamel it retains the ability to repair and reform after the tooth is erupted. (A new filling is sensitive to hot and cold until the dentin seals off beneath it.)

Within the dentin is the pulp of the tooth, containing the nerve roots and blood vessels. The blood vessels provide the nourishment for the dentin. The enamel does not heal, repair, or reform after it erupts from the gum--it is dead.

There is a slight constriction at the point that the enamel intersects with the root. This constriction is called the neck of the tooth. Usually it lies just underneath the gum line but will be exposed to direct view in certain disease processes of the gum.

The root of the tooth is made of dentin and it is anchored in the jaw bone socket by cementum. The socket is called an alveolus. Most of the pulp and all of the dentin is formed from the embryologic tissue called mesoderm. This tissue gives rise to the bone, muscles, and ligaments. Defects of the dentin are frequently associated with defects of these organs.

The crown forms first and apparently directs the formation of dentin. It is possible to have a crown without rootsbut not roots without a crown except thru trauma. When we see roots on X-ray without a crown we know that the tooth has been broken off.

Crowns that are complex in structure with many bumps (cusps) on them are formed in pieces with each cusp having its own enamel laid down followed by its own dentin. These pieces then fuse into one large complex tooth. Simultaneously each major piece directs its own root formation, resulting in a multicusped tooth with two or more roots. But all teeth have the same basic parts no matter how complexly they are humped and twisted.

If the fusion of the pieces is incomplete then the tooth will be laid open to easy decay.

The exact embryologic development of the tooth is out of the scope of an article written for dog lovers, but the bibliography will direct interested readers to the proper sources. See drawing 1.

Finally it should be stressed that the enamel is not hard when it first erupts. At five or six months of age when most of the crowns have erupted, the enamel can be peeled with a hard object such as a scalpel. Therefore it is wise to provide tough but not hard substances for the puppy to chew on. Leather, tendons, wood will all suit the purpose. After the dog is over a year old, he is unlikely to find anything to chew on that is as hard as his own enamel. But prolonged chewing on hard or gritty objects will gradually wear away the crowns.

IV. First appearance:

Chart I shows the order of formation of the crown and roots of the milk teeth. It also shows the time of eruption and finally extrusion of these teeth.

It is noted that the crowns of all 28 milk teeth are forming prior to the puppies birth. The first seen will be the canines and second premolars. None of the roots form until after birth.

Eruption of the milk teeth begins at about one month of age with the incisors slightly preceding the canines which are in turn rapidly followed by the premolars and molars. The entire process of eruption is not complete in the premolars at the time the incisors are already being shed. The whole process ends by the 5th month.

The last teeth to be lost are the canines and the first and second premolars. This has a special significance. Many people become worried because their dog has a double canine. What they are seeing is the permanent canine arising slightly inside and rearward of the milk canine. They may coexist for several months but eventually the primary tooth will be shed. If it is not gone by six months I usually pull it out although this is not necessary.

The advancing crown of the permanent tooth erodes the root of the primary tooth but does actually push it out.

Secondly, in the case of the premolars the late shedding gives rise to a peculiar woe of dog owners. They think their dog had his tooth broken off. This idea arises from the fact that the 1st deciduous premolar occupies the place that will later be occupied by the 2nd permanent premolar; while the second deciduous premolar occupies the place that will be occupied by the 3rd permanent premolar in the upper and lower jaw. In the upper and lower jaw the deciduous molar occupies the place of the 4th permanent premolar. These permanent premolars are late in erupting and look much like the deciduous premolars except that the permanent teeth are larger. Therefore, when the milk tooth is shed, the owner believes his dog has lost a permanent tooth. (See drawings 2, 3, 4, 5, & 6)

On the other hand, congenital absence of the permanent 2nd, 3rd, and 4th premolars is not uncommon. Frequently the deciduous premolar will be retained even for years, masking the fact that the dog is truly missing teeth. It is not always easy to tell. Generally speaking, the milk tooth is more chalky in color and smaller, but sometimes the adult teeth are small and it takes an expert eye to tell a retailed milk tooth.

Finally, it is to be noted that the crown is formed prior to eruption while the root is still forming at the time that the eruption process is already well under way.

V. Permanent Teeth:

Chart II shows the order of formation of crown, root and eruption of the permanent teeth.

In contrast to the milk teeth the crowns of none but the 1st lower molar are under formation prior to birth. This is similarly true in the human. However, about ten days after birth the permanent crowns do begin formation and this occurs before eruption of any of the milk teeth.

After the first lower molar the crowns of the canines and incisors, upper and lower all form, followed by $\frac{5}{5}$, $\frac{8}{8}$, $\frac{9}{9}$, then $\frac{6}{6}$, $\frac{7}{7}$, $\frac{8}{8}$ and finally $\frac{10}{10}$, $\frac{11}{11}$, and $\frac{10}{10}$.

The eruption sequence, however, is different. A check of the chart will show that. The process begins just after the 3rd month and is complete by the tenth.

Like the deciduous teeth, the permanent crowns and roots take some time to develop. The process in the permanent teeth takes about three months per crown as against about one month in the milk teeth, however. But since the mass of the permanent teeth is more than three times greater than the comparable milk teeth the rate of formation is probably greater.

Any damage to the formation of the crown must occur prior to its eruption. "Distemper teeth" for example are only seen in that part of the crown that is unerupted at the time of the disease process. The virus of this disease will cause a cessation of enamel deposition. The tooth upon complete eruption will have pits and valleys opened into the crown, exposing the dentine underneath. Apparently the virus has no effect on dentine formation. Dentin will discolor yellow-brown when exposed to air and there will be unsightly ridges in the teeth. They are not seen often nowadays because of effective vaccines.

The last tooth to erupt is $\frac{11}{11}$ and this can be as late as the sixth month of puppy life. The last tooth to fully erupt is the canine and it does not reach its maximum size until the ninth or tenth month.

Nevertheless an examination of the teeth at 5 to 6 months will usually tell if they are all there or not.

It should be stressed that there are wide departures from these schedules among various dogs so that no owner should panic because of any lag or delay in eruption as great even as two months.

When the teeth are finally erupted, it is seen that the closure rests in two places. In the front of the mouth the lower incisors come to rest behind the upper incisors. The lower canine fits into a groove between the upper third incisor (often called the "corner" incisor) and the upper canine. In the rear of the mouth there is a tight interlocking contact of the cusps of the upper fourth premolar and the lower first molar - the massive carnassial teeth, with the upper closing to the outside and over the lower. To a lesser extent the upper first and second molars make contact with the first and second lower molars. The third molar of the lower jaw is very small, making contact with the gum behind the second upper molar.

There is no contact between the upper first, second, and third premolars and the lower first, second, third and fourth premolars. Even when fully erupted the crowns of these teeth fall short of one another by about ¼ inch. The space between the canine and the carnassials is often called the "carrying space" because it is here that the animal carries most things.

The incisors are used for nipping and cutting. The canines for piercing and holding. The premolars are adapted to holding. The carnassials are for cracking and shearing, while the molars are used for grinding. The mouth of the dog is too large, the cheeks too weak, and the tongue ill-designed for good grinding. Consequently, when the dog attempts to grind he makes a mess - as any dog owner knows.

VI. Variations:

A. Man, seal, cat and dog are among those animals wherein many variations from the normal, or usual pattern occur. (The reader is directed to charts III and IV to familiarize himself with the details of each tooth, because there is no other way for him to become expert in this matter.) These variations in the dog are so common that the expression normal means "pertains to about 80% of specimens."

The most common single variation in the dog is the extra tooth. About 10% of dogs have extra teeth. Far and away the most common of these is the extra first premolar. This is written (55) in code. This extra tooth can be an exact duplicate of its mate or may be smaller, or occasionally may be incompletely fused to its mate, presenting the picture of a double-cusped 5. There are dogs who have this on both sides of a jaw or on the same side in both jaws; i.e., (55) (55) or (55) and (55) . I have never seen a dog with more than two (55) but there is no reason why they should not occur.

The extra 5 is frequently associated (statistically significant level) with missing teeth which may occur in the same jaw on the same side, or other side, or occur in the opposite jaw either side.

Occasionally the second premolar is doubled (66) but this occurs in less than l% of dogs. It can be distinguished from a (55) because of the elaborate cusp pattern of 6 and on X-ray because 6 has two roots rather than one, as does 5.

A much rarer finding is the double third molar of the lower jaw (11 11). I have seen this in only 4 dogs. Again the duplicate may be an exact copy or only a little runt compared with its mate. Bodingbauer owned such a dog in 1935 and was the first to describe this rare anomaly.

The remote ancestors of the dog had a third molar in the upper jaw but I have never seen this phenomenon repeated by "atavistic reversion."

Another rare variation is a third set of teeth. A nine year old dog grew a third set of teeth when his permanent teeth were extracted. This has been reported in humans too.

The "enamel drop" or a tooth composed of crown only with no particular configuration is reported from time to time, occurring within the dental arch or inside of it on the palate.

Occasionally one sees a fused tooth. These are called macro-teeth. The ones I have seen occur in the incisors. The first and second incisors are formed in one broad tooth, coded as 1.2 or 2.3.

There are innumerable minor variations in the cusp patterns seen but there is no point in discussing them further.

A common occurrence is missing teeth. Almost any tooth could be missing in theory but in fact there is a definite predilection for certain teeth to be missing. Most commonly it is the fourth premolar in the lower 8. And for reasons not clear the right 8 is missing twice as frequently as the left 8. Other teeth commonly missing are the central lower incisors 1, the second premolars 6, the third premolars 7, the third molars 11, occasionally the second molar 10 and the first premolar 5. No instance of a missing second or third incisor or canine was seen. Also there was no instance of a missing carnassial tooth. This giant shearing tooth, the largest in the dog is the fourth premolar in the upper jaw 8 and the first molar in the lower jaw 9.

In Arnall's series which included mostly short-headed dogs and many old dogs who might have lost teeth through trauma, the distribution was somewhat different. In those animals, 11, was the most commonly missing tooth, followed by 8 and he reported every tooth might be missing except the upper third incisor 3, the upper canine 4 and the carnassials 8 and 9.

It is interesting to note that Bodingbauer reports from a study of the skulls of stone and bronze age dogs that they were missing the same teeth in roughly the same order of frequency that I have found in the modern Doberman.

Approximately 15 to 20% of Dobermans are missing some teeth. Some of these also have extra teeth. And occasionally one finds an animal with missing, extra, and fused teeth.

B. The Jaws:

The upper jaw is called the maxilla; the lower jaw is called the mandible. These structures are bone, of course, and form independently of the teeth. Consequently, there are dogs with small teeth in large jaws and conversely dogs with large teeth in small jaws.

The former condition is seen in all dogs as they grow older. There develop gaps between teeth which are due both to wearing away of the teeth and to growth of the jaw bones. Since the teeth do not grow after complete eruption, the spaces between them grow larger as the years pass.

If both jaw bones are long we call the head: dolichocehalic. Most Dobermans are now of this type head. Most German Shepherds are of the mesaticephalic head type with a shorter muzzle. Since the teeth are the same size it is necessary that the third and fourth premolars rotate their forward edges in because there is not enough space to accomodate them running along the jaw bone axis.

When the muzzle is shorter than this we call the head: brachycephalic. In the old days there were Dobermans with mesaticephalic and brachycephalic heads but they are rare nowadays.

In the brachycephalic head the third premolars are rotated in to the degree that they are at right angles to the long axis of the jaw bone. Also the fourth premolars are turned in to a 30 degree angle. In these three types of heads the bite is normal.

The fourth type of head — the extreme brachycephalic head does not occur in nature in any but mutants. These dogs, such as the boxer, bulldog, Pekingese have a disproportionate underdevelopment of the maxilla compared with the mandible and are called under-shot. In such a head the second, third, and fourth premolars are turned at right angles to the jaw bone axis. However, the teeth are the same relative size as in the long headed dog. However, these premolars are frequently missing in the extreme brachycephalic dog. See drawing 7.

There are occasionally dogs with an underdevelopment of the mandible. In this case we call the dog over-shot; the condition is called micrognathia and occurs in all animals.

(The bone around the roots is organized independently from the bone of the jaw but it becomes "glued" onto the jaw bone in a fusion process that erases the line of connection. Nevertheless if there is no crown, then there will be no roots. And if there are no roots, then there will be no socket (alveolus). If the tooth has been pulled out, the socket will gradually heal over but never so completely that there will be no trace of its former occupant. On X-ray we can differentiate the missing from the lost tooth.)

These dogs are severely handicapped because their shearing capacities are reduced. They are rapidly eliminated under natural conditions. But under the "guidance" of man they exist to suffer from associated chronic sinus trouble, deviation and occlusion of the nose, besides slobbering on everyone and everything. Such is the folly of man. (See drawing 7)

VII. The Patterns of Inheritance:

Nearly all authorities agree that missing teeth represent an inherited defect or variation. Surely, missing teeth tend to beget more missing teeth. But the exact mode of inheritance has never been elucidated for any species. In man, all known patterns have been suggested and pedigrees have been brought forth in support of each particular pattern.

There are 6 main patterns of inheritance: the autosomal dominant, the autosomal recessive, the sex-linked dominant, the sex-linked recessive, the progressive pattern, and the polygenetic pattern.

I have tested by breeding all these patterns except the autosomal recessive (which I inconclusively tested) and the polygenetic. In my breedings the autosomal recessive seemed most to fill the bill, providing the breeder proceeds by considering each tooth as an integral unit.

There are hazards to this approach. The tooth is not a simple structure. As we have seen, it is composed by several kinds of cells and it may very well be that a tooth may be missing as a result of a half dozen or more different genetic alterations all coming together in the same puppy; or it may be that there are several critical genetic steps, any one of which missing would result in the whole tooth being absent. In that way there may be several different patterns of inheritance.

The matter must stand in abeyance until more work is done to elaborate the solution. Until then it would seem wise to avoid breeding dogs with missing teeth - all things being equal - if we are to avoid increasing the rate of frequency of missing teeth.

To the problem of extra teeth I would say to disregard it since the presence of extra teeth in no way bothers the animal.

A summary of the teeth missing in 150 Dobermans: Not a random sample:

Right Upper		Left Upper	
1	Once	1	
2		2	
3		3	
4		4	
5	Four times	5	Five times
6	Once	6	Once
7	Three times	7	Two times
8		8	
9		9	
10	Once	10	Two times

Right Lower		Left Lower	
1	Three times	1	Two times
2		2	
3		3	
4		4	
5	Once	5	Once
6	Two times	6	Four times
7	Three times	7	Once
8	Thirteen times	8	Seven times
9		9	
10	Two times	10	Two times
11	Two times	11	Two times

VIII. Strength and Disease:

How strong are the jaw and teeth of the Doberman? They can crack a black walnut with ease; they can bite through a cow's foreleg 1 ½ inches (3 cm.) with ease; they can bite through a 3/4 inch indestructible plastic-rubber doggy tug-of-war with ease. No one has measured the exact force that can be brought to bear but it surely is in the tons per square inch range. A man who sticks his hand into a dog's mouth to keep him from biting is an idiot. A one-handed idiot.

But the teeth are not indestructible. Lack of exercise will allow the teeth to loosen in their sockets. It is essential for good dental health that the dog be given something to chew regularly. I do not share the many injunctions against bones. Dogs have been chewing bones for thousands of years. I prefer the knee or ankle of a cow. The attached Achilles tendon will have proper resiliency for a good jaw-muscle workout and the bone will scrape the tooth free of calculus.

Calculus is a stoney hard material that accumulates on dog and human teeth after puberty. Prior to that time only a soft brownish scale accumulates on the teeth which can be rubbed off with a rough towel. (Remember the warning against scraping the tooth with a hard object prior to the first birthday). After puberty (about 18 months in the Doberman) there is some change in the salivary gland secretion which is responsible for the deposition of calculus on the surface of the teeth. It first appears on the cheek side of the upper molars adjacent to the opening of Stenson's Duct from the parotid gland, but soon it spreads to cover the cheek surfaces and lip surfaces of all the teeth. To a much lesser extent it will be found on the tongue surface. Not only is it unsightly but being rough it catches food and tends to give a bad odor to the breath. Furthermore, it allows debris to collect along the gum line, leading to abscess of the roots and infection of the gum.

This material must be removed at regular intervals. First get the dog a nice big bone (milk bone biscuits are not very effective in the Doberman). He will do most of the work for you. Then using a dental pick or similar dull metal object, you will press down on the calculus at an angle. It chips away easily, being brittle and only loosely bound to the enamel.

Cavities are not a problem in dogs if you keep sugar away from them. There is no reason to give a dog any kind of candy.

The majority of dog dental problems come from trauma. The advent of the woven wire fence was the worst thing that ever happened to the kennel dog. He will snap at it and crack his teeth off. The jaws are so strong that they can break through the tooth if the force is applied at an angle. The design nature gave was for the force to be transmitted down the shaft of the tooth to the cushioning socket. Nature never thought about woven-wire fences, I guess, and for you who have had this happen to your animals, I commiserate with you.

There are people who are skillful in filling cavities, repairing fractures, doing root canals on abscessed teeth, and even making false teeth. If you are lucky enough to find one, tell your friends so that they may avail themselves of his services.

IX. Concluding Remarks:

It is the nature of man that he seeks to understand that which he loves. Those of us who have owned and loved the Doberman for years or even decades find no detail of this magnificent animal unworthy of interest or study. The teeth are no exception. But all things must be taken in proportion. He who says that all dogs with missing teeth should be shot, is either overzealous or just a plain fool. The Doberman can live a very useful life with missing teeth, even several missing teeth. But if another man seeks to ignore the teeth in his breeding program "because they are not important" that man is just as foolish. There is no detail of this precious heritage that is not important. We must, all of us, seek to pass along this gift that has come to us through these seven decades unharmed and unmutilated. It is our burden of joy that we must study what has been, what is, and plan carefully for what is to be.

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DRAWING ONE

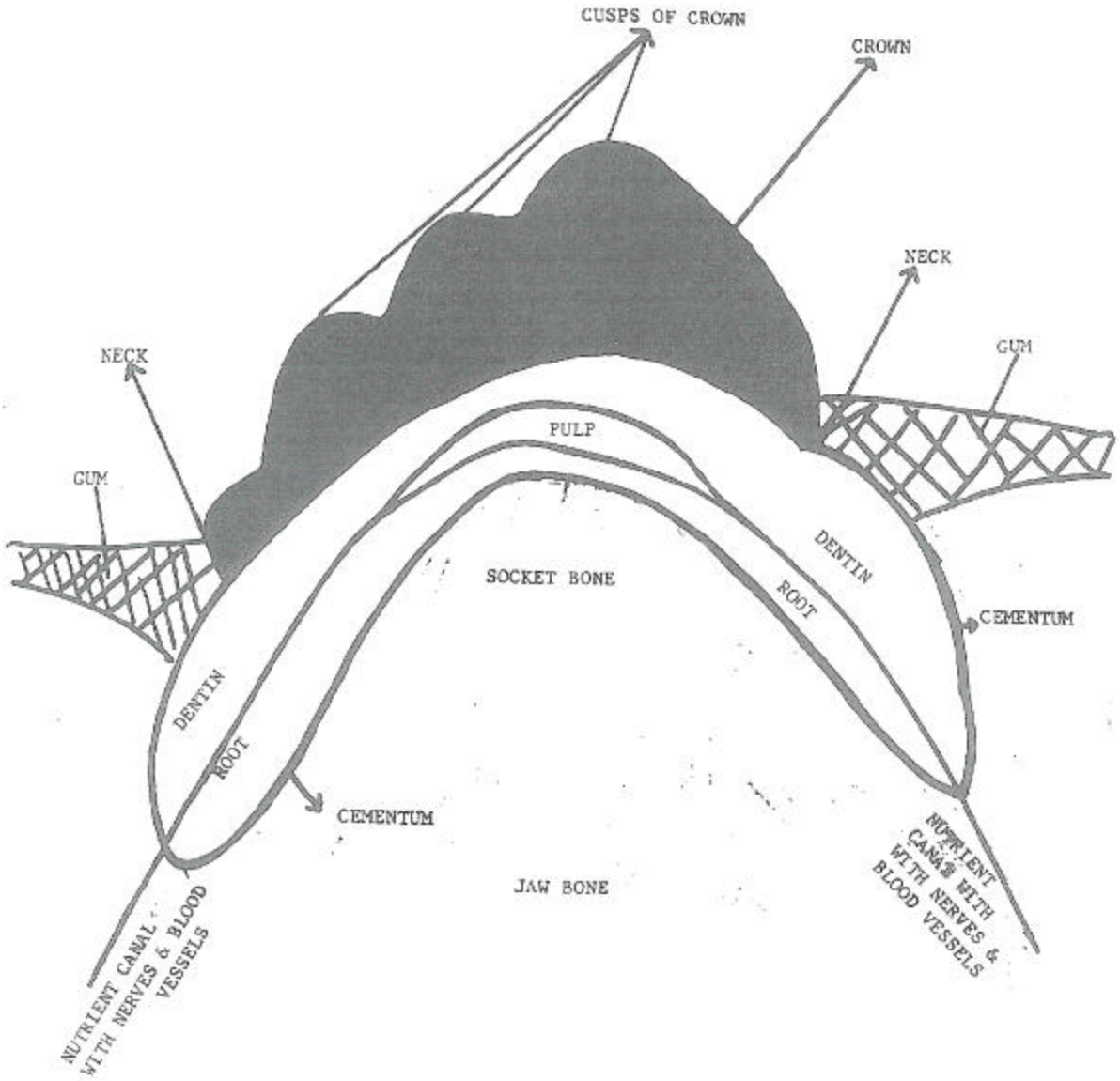


Chart I Tooth Upper	Conception 30 Day	Birth	1 Month	2 Months	3 Months	4 Months	5 Months	6 Months
I		CC	CCRRE	RR EEEEE	EEEEE	/		
II		CC	CCRRR	RR EEEEE	EEEEE	E/		
III		CC	CCRRR	RR EEEEE	EEEEE	E/		
IV		CCCC	CCRRR	RRR EEEEE	EEEEE	EEEEE	EEEE/	
V		CC	CCRRR	RRR EEEE	EEEEE	EEEEE	EEEEE	E/
VI		CCCC	CCRRR	RR EEEE	EEEE	EEEEE	EE/	
VII		CC	CCRRR	R EE	EEEE	EEEEE	EEE/	
Lower								
I		CC	CCRRR	RR EEEE	EEEEE	E/		
II		CC	CCRRR	RR EEEE	EEEEE	EE/		
III		CC	CCRRR	R EEEEE	EEEEE	EE/		
IV		CCCC	CCRRR	RR EEEEE	EEEEE	EEEEE	EE/	
V		C	CCRRR	RR EEE	EEEEE	EEEEE	E/	
VI		CCCC	C RRR	RR EEE	EEEEE	EEEEE	E/	
VII		CCCC	C RRR	RR EEEE	EEEEE	EEEEE	E/	

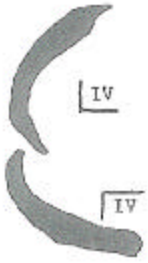
C = Crown Development
R = Root Development
E = Eruption Time
/ = is shed

Chart 2 Tooth Upper Jaw	1 Month Before Birth	Birth	1 Month	2 Months	3 Months	4 Months	5 Months
1		CCCC	CCCCC	CCCCCR	RRRRR EEEEE	RRRRR EEEE	R
2		CCCC	CCCCC	CCCCCR	RRRRR EEEEE	RRRRR EEEE	R
3		CCCC	CCCCC	CCCCCR	RRRRR EEEE	RRRRR EEEEE	R
4		CCCCC	CCCCCC	CCCCC	CCCRR	RRRRR EE	RRRRRR EEEEEE
5		CCCCC	CCCCC	CCCCC	RRRR EEE	EEEEE	E
6		CC	CCCCC	CCCCCC	CCCRR	RRRRR EEEEE	RRR
7		CC	CCCCCC	CCCCC	CCCCR	RRRRR E	RRRR EEEEEE
8		CCCC	CCCCCC	CCCCC	CCCCR	RRRRRR EEE	R EEEEE/
9		CCC	CCCCC	CCCCCC	CRRRR	RRRRR EEEE	EE
10				CCCC	CCRRR	RRRRR	EEEEE
Lower	Jaw						
$\overline{1}$		CCCCC	CCCCCC	CCCRR	RRRRR EEEE	RRRRRR EEEEE	R EE
$\overline{2}$		CCCCC	CCCCCC	CCCRR	RRRRR EEEE	RRRRRR EEEEE	R EE
$\overline{3}$		CCCCC	CCCCCC	CCCCC	RRRRR EEE	RRRRRR EEEEE	R EEEEE
$\overline{4}$		CCCCCC	CCCCC	CCCCCC	CCCRR	RRRRR EEEE	RRRRRR EEEEE
$\overline{5}$		CCCCC	CCCCCC	CCCCC	RRRR EE	EEEEE	EEEEEE
$\overline{6}$		CC	CCCCCC	CCCCR	RRRRR	RRRRRR EEEE	RRRR EE
$\overline{7}$		CC	CCCCCC	CCCCC	CRRRR	RRRRRR EEEE	RRRR EE
$\overline{8}$		CC	CCCCCC	CCCCC	CRRRR	RRRRRR E	RRR EEEE
$\overline{9}$	C	CCCCC	CCCCCC	CCCCR	RRRRR	RRRRRR EEEE	RRRR EEEE
$\overline{10}$			CCCCC	CCCCCC	RRRRR	RRRRR E	RRRR EEEEE/
$\overline{11}$				CCCCCC	CCCCC	RRRRR	R EEEEE

C = Crown Development E = Eruption Time R = Root Development

CHART III:
DECIDUOUS TEETH:

There are six milk incisors all looking alike. They have long slender shafts; the crowns are wider at the tip than at the gum; they are concave on the tongue side and convex at the lip side but nearly as pronounced in this respect as the permanent incisors are. The upper are like the lower except that III tend to be more hooked than III.



The milk canines resemble the adult canines except they are much more slender; they taper to a much sharper point; and they tend to be hooked like a "hawk's claw".

The first upper premolar (V) is much like the second adult premolar. It is longer than it is tall; it has two roots; it has a tall cusp forward and a small cusp rearward.

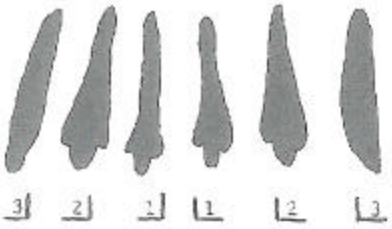
The second upper premolar (VI) looks much like the upper carnassial which is the fourth adult premolar. It has three roots: one forward, one rearward, and one running at right angles onto the palate; there are a large cusp forward and a small one rearward; this tooth is much broader than V.

The first milk molar is VII. It has two roots -- a heavy one forward and a light one rearward. It has a large cusp forward, a small one rearward and another small one on the tongue side of the tooth. In between these three cusps, which form a triangle, is a crude gringing surface.

The first milk premolar V in the lower jaw is identical to the first premolar in the upper jaw.
The second milk premolar is a larger version of the first milk premolar. VI is about 1½ times the size of V.
The first milk molar VII is much like the adult first molar. It has two strong roots; a cusp forward; a larger cusp in the center; and a crude grinding platform, ending in a small cusp.

CHART IV:
THE ADULT OR PERMANENT TEETH:

The lower incisors of the permanent dental arch are like large replicas of the milk canines. They have slender roots and are broad at the tip of the crown. When they first erupt there is a very tiny sharp cusp on the lateral side of 1 and 2, but this wears away soon and is not seen. 2 is larger than 1. 3 is more rounded at the tip of the crown; is larger than 2; and has a very pronounced lateral cusp.

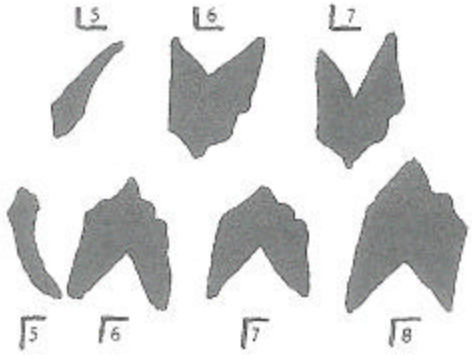


The upper permanent incisors differ considerably from their milk counterparts. 1 and 2 have a large cusp flanked by a small cusp on either side. 2 is larger than 1. 3 resembles a small canine, being formed a one stout shaft with no flanking cusps. Indeed it is a small canine as the lower canine lies just behind it when the mouth is closed, forming a "tongue-in-groove" lock with upper canine. All of the upper canines have a shelf on their tongue side. It is here that the tips of the lower incisors come to rest, forming a mortise closure.

The roots of all the incisors are slightly longer than the crowns.

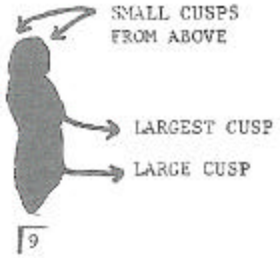
The appearance of the canines is familiar to everyone. It is worth noting, however, that the roots of 4 are two to three times longer than the crown, and they sweep back under the roots of 5 and 6.
The upper canine is slightly longer and is more slender than the lower canine.

CHART IV:
CONTINUED:



$\overline{5}$ is a small, single-rooted tooth. It lies just behind the canine which places it farther forward in the lower jaw than in the upper jaw. It is of special interest because it is frequently doubled or missing.

5, 7 and $\overline{6}$, $\overline{7}$, & $\overline{8}$ are identical. They resemble the structure of the first milk premolar V except that they are much larger usually. They all have two roots; a large forward cusp and a smaller cusp behind. Each successive tooth is larger, moving rearward in the mouth. Members of this series are frequently missing.



The first molar in the lower jaw, $\overline{9}$, the "carnassial" tooth is the largest tooth in the mouth. Like the premolars it is longer than it is high. There is a large forward cusp followed by a still larger middle cusp, followed by a smaller cusp. This last cusp, extending about ⅔ the length of the tooth, has a partner cusp on the tongue side, and between the two is a small grinding surface.

There are two roots.

CHART III:
CONTINUED AGAIN:

The fourth premolar in the upper jaw, 8, the "carnassial" or "sectorial" tooth is the second largest tooth. Like 9 it is a little more convex on the cheek side than it is on the tongue side. It has one very large forward cusp and a smaller cusp behind. There is a very deep groove between them which is a frequent site for decay. Seen from above it will be noticed that there is a very small projection off the large cusp onto the palate and under this projection is a tiny root. There are two other roots, the forward one is longer but more slender than the rearward root.

The second lower molar, $\overline{10}$, is a duplicate of the rearward ½ of the first lower molar. It has four cusps, two on the cheek side and two on the tongue side. Those in the forward part of the tooth are slightly larger. From above the tooth is square. There are two roots. It is entirely a grinding tooth.

The third lower molar $\overline{11}$ is a poorly defined version of $\overline{10}$ but is only one third as large. It has only one root. This tooth is frequently missing and occasionally is doubled.

CHART IV:
CONTINUED:

FROM ABOVE

9

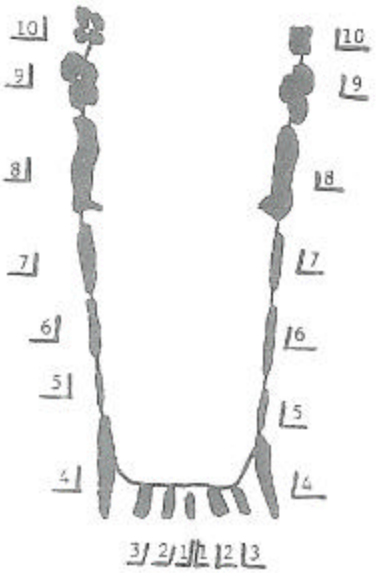
The first upper molar, 9, has four cusps. The cheek-sided ones are larger with the forward cusp being larger than the rear. The cusps are rounded. The function of this tooth is entirely grinding. From above the tooth looks like a cloverleaf. There are three roots; two on the cheek side and one on the tongue side.

10

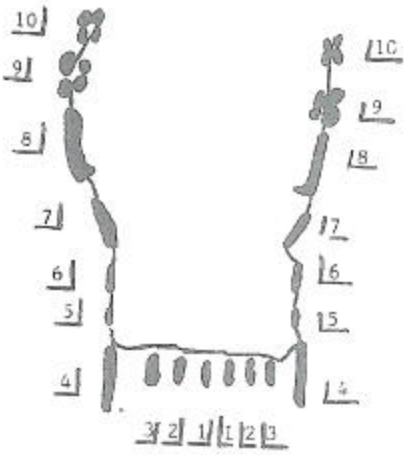
FROM ABOVE

The second upper molar is like the first but is only one third the size. It is 10.

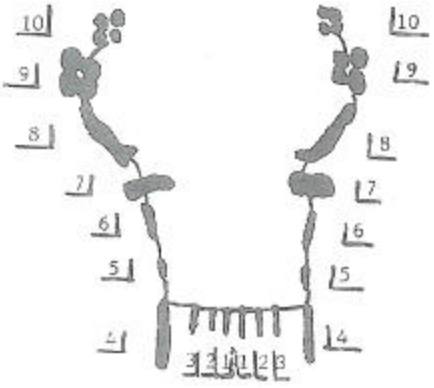
DRAWING 7
DENTAL ARCH OF UPPER JAW AS SEEN FROM UNDERNEATH:



Dolichocephalic



Mesaticephalic



Brachycephalic

Extreme Brachycephalic

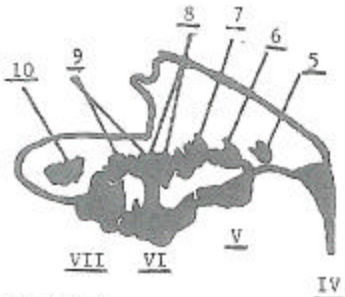
DRAWINGS 2-6

DRAWING 3

Mandible showing partially erupted adult teeth along with milk teeth.

DRAWING 2

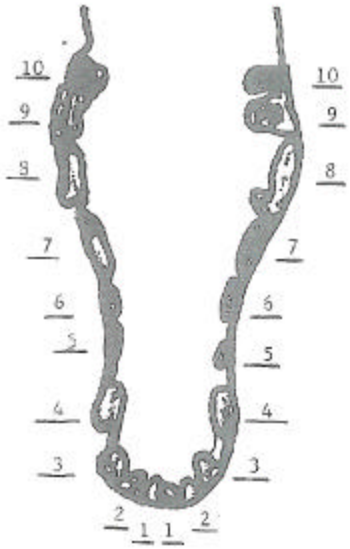
Mandible showing milk premolars and molars.



DRAWING 4

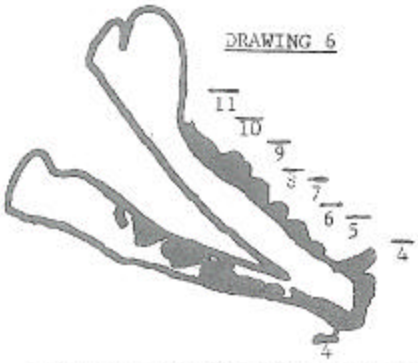
Maxilla with milk teeth, showing crowns of adult teeth forming under them.

DRAWING 5



A view of the maxillary dental arch. The sequence of permanent dentition.

DRAWING 6



Schematic drawing with adult dentition of mandible. (Mandibular dental arch).