



Dear Colleagues, How Long Ago Were You in Dental School, Studying Your ABC's-AKA-Dental Anatomy? One Year Ago, Five Years Ago, Ten Years Ago.....More?

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Ladies and Gentlemen please get ready for a stroll down Memory Lane with me! The purpose of this paper is to reinforce the reasons that you do what you do every day sitting in your operatory next to your patient providing the best quality of dental care for each of them. I was asked to write this paper as a gentle refresher of many of the things all dental professionals know and unknowingly think about every day!

Lecturing in Dental Anatomy at Tufts University School of Dental Medicine has been my honor and pleasure to do for their students for the past 30 years. When I would stand in front of the class, or Zoom with them on my computer screen, I begin at the beginning with the development of our "Magnificent Pearly Whites"!

Now, in utero the oral mesenchymal tissue begins to differentiate into entities called "Dental Lobes". These Lobes coalesce and form our Deciduous and Permanent Dentitions. I do understand this is very elementary, but I want to remind you that there are 26 Permanent teeth that develop from 4 Lobes, and 6 Permanent teeth that develop from 5 Lobes. The next concept that I usually introduce are the different shapes of our Permanent teeth, because the form of our teeth follows the functions of these teeth. The Maxillary and Mandibular Anterior teeth are Wedge shaped from the Proximal, coupled with their flat or cusped Incisal Edges, they can easily pierce the food we eat. The Maxillary Premolars and Molars are Trapezoidal shaped from the Facial and Lingual, as well as from their Proximal surfaces. Their Occlusal Tables are built to grind and break down the food bolus into digestible pieces. The Mandibular Premolar and Molar teeth are Rhomboidal shaped from the Proximal, while the Facial and Lingual surfaces are Trapezoidal shaped. Their Occlusal Tables are shaped to grind and crush ingested food to be swallowed to comfortably travel down our alimentary tract.

In my many years of Dental Anatomy study and reading, I have discovered several General Rules and they are as follows:

1. The Mesial Surface of all Permanent teeth when viewed from the Facial or Lingual, is Straighter, while the Distal Surface is more Curvaceous.

2. The curvature of the CEJ is either in an Incisal direction, or an Occlusal direction. The most dramatic curvature occurs on the Mesial surface of the Permanent Maxillary Central Incisors. As we move posteriorly, the curvature becomes much less; when we get to the Maxillary Molars, it is almost a perfect circle. Concerning the Mandibular Permanent teeth, the greatest curvature of the CEJ occurs on the Mesial of the Central Incisors and decreases as we move posteriorly. The curvature of the Deciduous Dentition follows the same pattern as the Permanent Dentition.....So the curvature of the Permanent Maxillary Central is greater than the Curvature of the Permanent Mandibular Central which is greater than the curvature of the Deciduous Maxillary Central which is greater than that of the Deciduous Mandibular Central. Mesial curvature is always greater than Distal; the curvature of the Permanent dentition is always greater than what occurs in Deciduous teeth.
3. Permanent Maxillary Anterior teeth will almost always present with 1 root, and 1 root canal.
4. All Permanent teeth converge Lingually except for the Maxillary First Molar; It is larger Lingually than Facially in a Mesio-Distal dimension.
5. All cusps possess 4 Cusp Slopes: Facial, Lingual, Mesial, and Distal. The Distal Slope is always longer EXCEPT for the Maxillary First Premolar, whose Mesial Cusp Slope of the Facial Cusp is longer than the Distal Cusp Slope. Every Cusp will present with a

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Pulp Horn. Both Maxillary and Mandibular Incisors may have a Mesial and a Distal Pulp Horn. Taking the “Cusp” information a bit further, Triangular Ridges occur ONLY in Posterior teeth. They are Cuspal Ridges that run from cusp tips onto the Occlusal Tables, I.E., the Lingual Ridges of any Facial Cusp are Triangular Ridges. The union of 2 Triangular Ridges is a Transverse Ridge. FYI, the Permanent Maxillary First Molar’s Mesio-lingual Cusp possesses 2 Triangular Ridges, therefore being the ONLY cusp that possesses this trait.

6. A Triangular Fossa is a Fossa located right next to any Marginal Ridge normally found on the Occlusal surface of Posterior teeth. Yes, believe it or not, one can find a Triangular Fossa on the Lingual Surface of a Permanent Anterior tooth, too!
7. All Permanent teeth are shaped like a Trapezoid from the Facial and Lingual. Maxillary Permanent Posterior teeth are Trapezoidal from their Proximal surfaces, as well. Mandibular Permanent Posterior teeth are shaped like a Rhomboid from their Proximal surfaces.
8. All Permanent teeth have their Facial Height of Contour in the Cervical Third. The Maxillary and Mandibular Anterior teeth possess a Lingual height of contour in the Cervical Third, as well. Both the Maxillary and Mandibular Permanent Posterior teeth have their Lingual Height of Contour in the Middle Third of the tooth, EXCEPT for the Mandibular Second Premolar; Its Lingual Height of Contour occurs in the OCCLUSAL Third.
9. All Proximal Surfaces have FOUR Embrasures: Incisal/Occlusal, Facial, Lingual and Cervical/Gingival. Facial embrasures are always Smaller than Lingual embrasures EXCEPT in the case of the Permanent Maxillary First Molar. This tooth possesses Smaller Lingual embrasures because it converges Facially, not Lingually. Also, the Mesial embrasures of the Permanent Mandibular Central Incisors are Equal, due to the very uniform shape of these teeth.

I would like to begin to discuss the Permanent Dentition, tooth by tooth.

The Permanent Maxillary Central Incisors are the Widest Anterior tooth in a Mesio-Distal dimension, while having the Second Longest crown in an Inciso-Cervical direction. They may erupt, appearing a little short, long or even very square. Most often they have a Facial Surface with slight Developmental Depressions (showing the coalescence of the 3 Facial Lobes) that run in an Inciso-Cervical direction. They present with a fairly detailed Lingual anatomy consisting of a Lingual Fossa, Mesial and Distal Marginal Ridges, a Cingulum- and even a pit may be seen! They possess a straight Incisal edge and erupt with 3 Mamelons. These teeth, from the Facial have a Mesial Incisal angle that is sharp, while its Distal is softer and more rounded.

The Maxillary Lateral Incisors, next to the Permanent Third molars, erupt with the most developmental anomalies. There may be a tooth that is Missing; a Peg-lateral (this tooth has a non-descript form); a Dens-En-Dente (tooth with-in a tooth); a Twisted Root; or a Distorted Crown. The Distal Incisal angle is quite rounded, while the Mesial is straighter. We have 1 root and 1 root canal. The Lingual surface of the Maxillary Lateral Incisor is said to have the “Most Detailed Lingual Anatomy of all the Permanent Anterior teeth”. It will possess a Lingual Fossa, a Cingulum, Mesial and Distal Marginal Ridges, a Groove that will run from the crown into the tooth’s Cementum, and most often a Lingual Pit. This is an area where we may see an uptick of decay and periodontal disease.

The Permanent Maxillary Canines (along with the Mandibular Canines) have been deemed the “Cornerstones of the Dental Arch”. The Maxillary Canine is the Longest tooth in the Permanent Dentition. It possesses the Longest Root and is Very strong and stable so it can do its job of piercing, holding, and incising the food to be chewed and swallowed. It is the Widest Anterior Tooth in a Facio-Lingual dimension. The Facial surface may present with slight Developmental Depressions running Vertically through the Cervical and Middle Thirds of the tooth. Canines are important in orthodontics for diagnostic purposes, too. This is a Cusped tooth with the Distal Cusp Slope longer than its Mesial Cusp Slope. The Lingual surface possesses Mesial and Distal Marginal Ridges, A Lingual Ridge, Mesio-lingual and Disto-lingual Fossae, and a Cingulum that can look like a small cusp. This is the Last Permanent tooth to erupt (except for the Third Molars).

The Mandibular Central Incisor is the First Permanent tooth to erupt. It also erupts with 3 Mamelons. These teeth are as Smooth as Silk and you will not find any Developmental Depressions on the crowns of them. They are the Smallest Permanent teeth, and in my Humble opinion, the Most difficult to restore with a crown. The Permanent Mandibular Central may possess a bifurcated root, and more than 1 root canal. Its Incisal Edge is straight, and both Mesial and Distal Incisal Angles look identical. The Lingual surface has a Fossa, Mesial and Distal Marginal Ridges, and a Cingulum, but all are so indistinguishable, again appearing very smooth.

The Permanent Mandibular Lateral Incisors possess the same characteristics as the Central Incisors, but the Laterals are a larger tooth. What is quite noticeable with these teeth is their Distal Incisal Angles—they are very rounded; I would call them almost Obtuse! If there is a root canal bifurcation or 2 root canals-1 would be located Facially, and 1 located Lingually. My suggestion would be to look for 2 canals in both the Central and Lateral Incisors if one is going to perform endodontics on these teeth.

The Permanent Mandibular Canines, also known as the “Cornerstones of the Dental Arch”, possess the LONGEST crown in the Permanent Dentition. These teeth are cusped teeth and possess a Longer Distal Cusp Ridge than Mesial. The crown of the Mandibular Canine is smoother than its Maxillary counterpart, however you may see

Developmental Depressions on the Facial surface of these crowns. Their jobs are the same as the Maxillary Canines, holding, piercing, incising and they are quite well equipped for this calling. The crowns of these teeth appear twisted on their axis, in a Distal inclination. Their shape conforms to their ability to fit quite well within the smaller Mandibular arch/parabola with ease. The Mesial surface (both crown and root) from a Facial view, appears Straight. The Lingual surface is a smoother version of the Maxillary Canine, with Mesial and Distal Marginal Ridges, a Lingual Ridge, Mesio-lingual and Disto-lingual Fossae, and a distinct Cingulum. The root may bifurcate, as well as the Canine's root canal. In fact, you will see this phenomenon in 1 of every 4 of these teeth. As an aside, I would tell my students that all 4 Canines are my Favorite Teeth, and to NEVER-EVER remove them, even if you must do treatment on them for Free!

The very first lecture I gave 30 years ago was describing the Permanent Maxillary Premolars, so, these Transitional Teeth are near and dear to my heart! There are 2 Premolars on each side of the Maxillary arch. These teeth cut, pierce and grind our food. As we move distally from our Incisors to our Canines and finally to our Posterior teeth, we see Incisal Edges, then Cusp Slopes, and settle in with Occlusal Tables (this occurs in both the Maxillary and Mandibular arches). These are the "Work Areas" of our dentitions.

The Maxillary First Premolar is so very unusual and distinct. I would tell my students to remember "Mesial, Mesial, Mesial". First, we find a Mesial Embrace that is the LARGEST in the oral cavity. WHY?? Its Facial Cusp's Mesial Cusp Slope is LONGER than its Distal Cusp Slope, so, coupled with the Maxillary Canine's Longer Distal Cusp Slope the Largest Embrace is seen. This is the ONLY tooth in the Permanent Dentition that possesses this trait of possessing a Longer Mesial Cusp Slope. Secondly, right below the Mesial contact is a depression that runs from the crown onto the root until it reaches the root's bifurcation. The Maxillary First Premolar is only 1 of 2 Permanent teeth that possesses this feature (the Maxillary First Molar has this phenomenon on the Distal side of its crown). Thirdly, when viewed from the Occlusal, the Lingual Cusp is skewed toward the Mesial.

The Maxillary First Premolar is the Largest Premolar, and the ONLY Premolar to have 2 Roots....1 Facial and 1 Lingual. The Maxillary Posterior teeth are Trapezoidal from all 4 surfaces. The Maxillary First and Second Premolars are shaped like a Hexagon when viewed from the Occlusal. Both Premolars possess a Central Groove, Mesial and Distal Marginal Ridges, Mesial and Distal Triangular Fossae, and 2 Occlusal Pits. The First has a clean Occlusal Groove pattern, while the Second has what I call "Mrs. Butler's Lips", because it has many Supplemental grooves appearing on its Occlusal surface. Both teeth may show subtle Developmental Depressions running vertically on their Facial Surfaces.

The Maxillary Second Premolar will most often possess 1 root and 1 root canal; however, they tend to bifurcate, too.

ALL Posterior Permanent Teeth possess the following features in different combinations. The Occlusal Table will present with Mesial and Distal Marginal Ridges, Triangular Ridges-some become Transverse Ridges, Mesial and Distal Triangular Fossae, Central Fossae, Pits, and a myriad of Grooves that show the coalescence of the Developmental Lobes. When performing restorative procedures, it is VERY important to Exactly re-create the shape of the missing portion of the tooth you are replacing!

Let's transition to the Mandible and review the First Premolar. This is our SMALLEST Premolar. It presents with a Large Facial Cusp, and a very Small Lingual Cusp. It has a Strong Transverse Ridge that runs from the Facial Cusp tip Lingually onto the Occlusal Table. On either side of it we find 2 Fossae-a Mesial, and a Distal. Within these fossae we see 2 Occlusal Pits. When these pits are restored, they have been called "Snake Eyes ". When teaching Restorative Dentistry, we warn our students to keep the Transverse Ridge intact unless one is removing decay. Most often, we have a tooth that has 1 root, and 1 root canal. We will find those subtle Developmental Depressions on the Facial surface running Vertically. The Mandibular Posterior teeth are shaped like a Rhomboid from the Proximal, while from the Facial and Lingual are shaped as a Trapezoid. The Mandibular First Premolar is Diamond shaped from an Occlusal view, and it has NO contact on its Mesial Marginal Ridge.

The Permanent Mandibular Second Premolar can erupt in 2 different forms. The first form is the 3 Cusped type (the most common version). This tooth possesses 1 Large Facial Cusp, a Mesio-lingual Cusp, then the smallest being the Disto-lingual Cusp. It may show 3 Occlusal Pits, a Central Fossa, Mesial and Distal Marginal Ridges, Mesial and Distal Triangular Fossae, and a clean Occlusal Groove pattern usually called a "Y" pattern. Just like the First Premolar, these teeth may show subtle Developmental Depressions running Vertically on their respective Facial surfaces. Both types possess a LINGUAL HEIGHT OF CONTOUR in the OCCLUSAL THIRD and are the ONLY Permanent Posterior to possess this characteristic. From an Occlusal View, the 3 Cusped Type looks like a Square, while the 2 Cusped Type is Round. The 2 Cusped Type has Mesial and Distal Marginal Ridges, Mesial and Distal Triangular Fossae, 2 Pits, and a clean groove pattern that looks like a SMILEY FACE!!

The real Workhorses of our Oral Cavity are the Molars. If fact, if you remove all of a patient's permanent teeth, the heaviest by weight is the Maxillary First Molar. This tooth is the Widest tooth in a Facio-Lingual direction of all our Permanent teeth. Both the Maxillary and Mandibular First Molars have also been called the "Cornerstones of the Dental Arches". Maxillary Molars are trapezoidal shaped from all 4 surfaces. The Maxillary First Molar is the ONLY Permanent tooth that is wider in a Mesio-distal direction on its Lingual surface, resulting in its Proximal Mesial and Distal Facial Embrasures being Larger than its Lingual Embrasures. We have a tooth that presents with 5 cusps – Mesio-facial, Disto-facial, Mesio-lingual, Disto-lingual, and a Cusp of Carabelli which is situated on the Mesio-

lingual Cusp's Lingual Surface. The Carabelli Trait will always appear on this tooth even if it only appears as a slight depression or a small groove. The First Molar possesses 3 Occlusal Pits- Mesial, Central, and Distal, along with a very distinct groove pattern. We see Mesial and Distal Marginal Ridges, and something unique to the Permanent and Deciduous Maxillary Molars an Oblique Ridge. It is formed by the union of the Mesio-lingual's Cusp Triangular Ridge and the Triangular Ridge of the Disto-facial Cusp. The Mesial, and the Distal Marginal Ridges have the same Cervico-Occlusal height as the Oblique Ridges. Just like the Mesial surface of the Maxillary First Premolar, right below the Distal contact of the Permanent Maxillary First Molar, we find a depression on the crown that runs onto the root. These are the only 2 Permanent teeth that possess this trait. This tooth possesses 3 strong roots- 1 large Palatal root, 1 Mesio-facial root, and 1 Disto-facial root. The Facial roots are apt to house multiple root canals, so always look for them when doing any endodontic procedures. I usually describe these roots as looking like "pliers" but in reality, doing a great job anchoring this tooth into the alveolar bone.

The Permanent Maxillary Second Molar is a smaller version of the First. The main differences are the lack of the Carabelli Trait, the converging of this tooth Lingually, and the presence of a small Disto-lingual Cusp. The Occlusal topography is like that of the First but we find many more supplemental grooves here. The Second Molar possesses 3 roots: a Palatal root, a Mesio-facial root, and a Disto-facial root- where the Facial root canals may bifurcate. These roots are more parallel than those of the First and can even be longer in their Cervico-apical length. The Lingual Cusps of Permanent Maxillary Molars are their Supporting Cusps, and they occlude on the Mandibular Molar's Marginal Ridges and Fossae.

The Permanent Mandibular Molars work very hard along with their Maxillary counterparts. These teeth are Trapezoidal from the Facial and Lingual, while being Rhomboidal shaped from their Proximal views. The Mandibular First Molar has 5 cusps: Mesio-facial, Disto-facial, Distal, Mesio-lingual and Disto-lingual. It is the Widest Permanent tooth in a Mesio-Distal dimension. We have an Occlusal topography that is distinct for this tooth; 3 Pits, 3 Fossae (Mesial, Central, Distal on both accounts), with, Mesio-facial, Disto-facial, Central, and Lingual Grooves. This tooth has 2 strong roots, 1 Mesial (whose root canal will bifurcate quite often), and 1 Distal root (which may bifurcate, but not nearly as often). Both roots do a terrific job in anchoring this tooth firmly into the mandible. It is Hexagonally shaped from an Occlusal view.

The Permanent Mandibular Second Molar is a very uniformly shaped tooth. It possesses 4 almost equally sized cusps- Mesio-facial, Disto-facial, Mesio-lingual, and Disto-lingual. We see Mesial and Distal Marginal Ridges; 3 Pits- Mesial, Central, Distal; 1 Central, 1 Facial and 1 Lingual Groove creating a "+" groove pattern. This tooth possesses 2 roots- 1 Mesial (whose root canal may bifurcate), 1 Distal (not as often). From an Occlusal view this tooth is shaped like a Square. The Facial Cusps of Mandibular Molars are

their Supporting cusps. They occlude on the Marginal Ridges and Fossae of their respective Maxillary Molars.

Now, Ladies and Gentlemen, both Maxillary and Mandibular Third Molars might erupt-or not! They present with the MOST Development Anomalies in both their crowns and roots. So as far as I am concerned, and in my Very Humble opinion, evolution should eliminate them because they are problematic quite often. My apologies to our esteemed Oral Surgeon colleagues!

In conclusion, I would like to thank each one of you for taking your precious time to read my thoughts regarding my lifelong love of Dental Anatomy. I hope and pray that our trip down "Memory Lane" was worthwhile, enjoyable and perhaps, swept out some of your cobwebs.