Introduction

Any major or minor differences of dental morphology have a great impact on anthropological researches and dentists. Anthropologists consider these differences are a reflection of the evolution process, which helps them to study the mechanisms of evolution. While dentists consider these differences as a variation of dental anatomy that should be considered to offer proper dental treatment on a scientific basis ***(Bailit, 1975).***

The root-crown ratio determines the relation between root length and the crown length. Root length being larger than crown length, aids in proper support and anchorage in the bone for normal function. Hence, the normal Root-crown ratio is thus termed as a favorable root-crown ratio ***(Newman et al., 2002).***

Many types of research, recorded variations in tooth size as mesiodistal or buccolingual dimension and tooth form like occlusal morphology. Which are important to determine diagnostic criteria in various dental specialties like orthodontics and restorative dentistry ***(King et al., 2010).***

It is essential to determine some common and uncommon variations, occurring in tooth anatomy concerning each tooth individually this helping in dental therapy such as restorative, root

canal treatment, orthodontic treatments, and also anthropological studies for people identification ***(Ramin et al., 2010).***

Root morphology and root canal systems are genetically determined, it is important to study them and their variations to apply a proper endodontic treatment ***(Silva et al., 2013)***.

Review of Literature

Differences in tooth form and dimension among human populations are due to differential growth rates ***(Kraus and Jordan, 1965)***, suggested that there are time-related and rate of growth differences between the differentiation of cusps and ridges (soft and hard tissue differentiation). Moreover, the size and the position of the crown are genetically controlled, especially, in the growth and development stage. This illustrates that dental characteristics like size, shape, presence, number, the pattern of cusps, and the size of the dental arches are genetically controlled and such characteristics vary among races and species due to natural selection and genetic changes.

Descriptive studies included observation of several individuals from a defined population recorded a range of variations specific for them that differentiate them from other populations. Particularly, the occlusal anatomy of the posterior teeth which represents a dental phenotype that is species-specific ***(Moss et al., 1967).***

Another descriptive dental study was done by ***(Biggerstaff, 1969)*** related to the unique pattern of the dental morphologic trait of Neanderthals to a genetic significance.

Most of the previous studies of the dentition have depended on traditional methods of measurement, like mesiodistal and buccolingual dimensions. Whereas there are

variations in the tooth itself like (size, shape, and position of individual crown components or in root and root canals), these variations should be investigated to overcome some clinical problems ***(Robert and Biggerstaff, 1969).***

There are two categories of dental morphological variations that could be considered: firstly, the major variations: these deviations from the known dental structure or morphology and secondly, minor variations in the tooth: variations in the crown or root morphology ***(turner, 1967; scott 1973 and hillson, 1996).***

A study of dental anatomy in the sense of external and internal morphology of the various teeth in the human dentition which includes shape, structure, root morphology, function of the teeth, and their relation to each other in the same or contralateral sides. This would help in proper dental treatment ***(Nelson and Ash, 2003).***

The internal morphology of the pulp chamber and root canals are determined by the external morphology of the crown and root and, therefore, it is significant for pulp pathology. Successful endodontic treatment cannot be performed without the knowledge of the root numbers, location, morphology, length, and orientation, as these parameters may differ from one person to another ***(Vertucci, 2005).*** As the internal morphology is important, the external morphology of the tooth is important as well this provide information about susceptibility to dental

caries and non-caries diseases of certain group of teeth and also to perform a proper treatment of the tooth, in form of complete functional and esthetic restoration ***(Nikolic et al., 2014).***

Occlusal morphology:

The cusp number and the groove pattern are considered separately since their evolutionary changes are not well correlated phenotypically ***(Devoto and Perrotto, 1972).***

An accessory ridge may be found on the occlusal surface of maxillary and mandibular premolars on mesial or distal sides. As the lingual segment of buccal cusps of premolar consists of three lobes, the central lobe exhibits the essential ridge and the accessory ridges on its mesial or distal sides. Distal ridges are more common than mesial ridges and they are higher frequency on second premolars than on the first one ***(Scott, 1973).***

Scott in **1973** reported higher frequencies of this accessory ridges in maxillary premolar in a sample of ten Southwest Native Americans compared to two American white.

Burnett, 1998 found these accessory ridges were common in Northeast Asian and Native American populations. Thus, the Variations in cusp number and groove pattern may be multifactorial inherited and dependent on a lot of genes, culture, living conditions, and diet ***(Berkovitz et al, 2002).***

Mihailidis *et al,* in ***2013,*** found Australian and Southeast Asians had lower frequencies of the presence of accessory ridges than Europeans and East Asians.

Classification for either maxillary or mandibular premolars, the accessory ridges should be scored in to: (Burnett et al., 2010) (fig.1)

Grade 0*:* the absence of ridge.

Grade T*:* truncated ridge (is not continuous from buccal cusp to sagittal sulcus)

Grade 1*:* trace (a slight, continuous ridge from buccal cusp to sagittal sulcus)

Grade 2*:* small (thin continuous ridge)

Grade 3*:* medium (moderately thick continuous ridge)

Grade 4*:* pronounced (thick continuous ridge)

Figure (1): Scale for maxillary premolar accessory ridges ***(Burnett, 2010)***

Occlusal morphology of Maxillary premolars:

Maxillary premolars generally have one common occlusal pattern this may be an oval or rectangular crown outline and greater buccolingually than mesiodistally ***(Robert and Biggerstaff, 1969).*****(fig.2)**

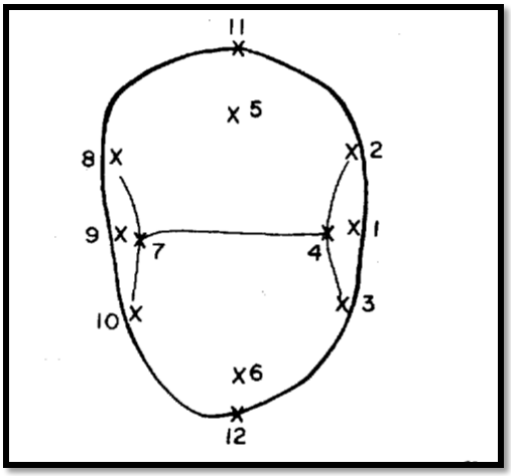

Figure (2): Occlusal outline of maxillary premolars ***(Robert and Biggerstaff, 1969).***

The buccal and lingual cusps of the maxillary premolars are separated by a sagittal sulcus. At either the mesial or distal margin of this sulcus, a small accessory cusp or tubercle may be present ***(Carlsen, 1987)***. In **1967. Turner** suggested classification to score a small accessory cusp "tubercle"

Turner`s classification, 1967 (fig.3)

Grade 0*:* accessory cusp absent

Grade 1*:* well-defined mesial accessory cusp with palpable cusp tip.

Grade 2*:* well-defined distal accessory cusp with palpable cusp tip.

Grade 3: well-defined mesial and distal accessory cusps with palpable cusp tips.

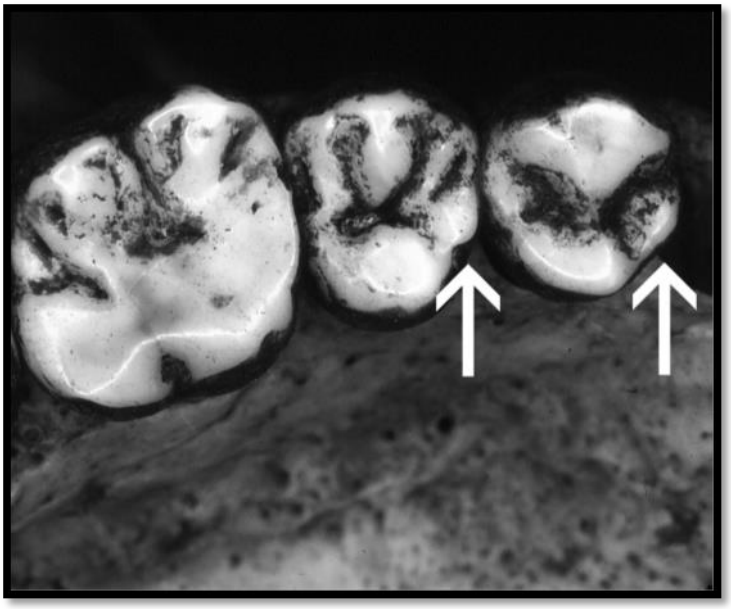

Figure (3): Showing accessory tubercles on the mesial side of maxillary first and second premolars ***(Turner, 1967)***

Maxillary first premolars:

Maxillary first premolars are described morphologically as showing two cusps and two roots but variations are also present. **Morris et al,** describe a rare variant of maxillary first premolars **in 1978** as the distal margin of the buccal cusp rotates away from the sagittal sulcus because the buccal and lingual cusps of the maxillary first premolar do not run in parallel axes. If straight lines are placed along the major axis of the buccal cusp and on the midline between the two cusps, the angle of divergence varies from 6° to 11°**.** But in the case of Uto-Aztecan premolar, the angle of divergence is two to three times greater than normal as it ranges from 35° to 45°. This rotation is accompanied by a pit at the distal side between the

distal marginal ridge of the buccal cusp and a crest from the essential ridge of the buccal cusp to the distal border.

Classification (Morris et al, 1978) (Fig.4)

Grade 0*:* absent

Grade 1*:* present

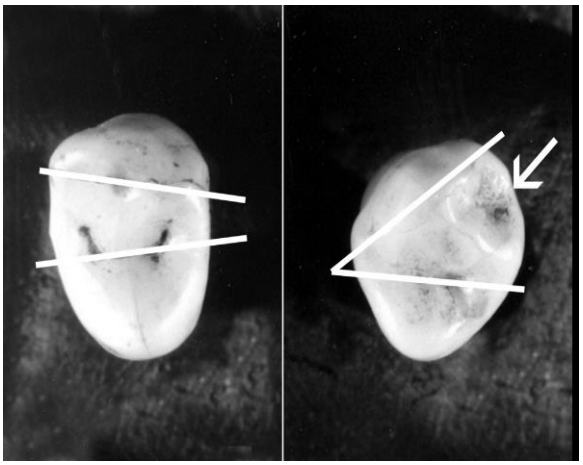

Figure (4): Left: normal maxillary premolar with some rotation of distal border of the buccal cusp, right: Uto-Aztecan premolar shows strong rotation and accompanied by a distal pit ***(Morris et al, 1978)*.**

A three-cusp pattern with Y- shaped occlusal groove in the maxillary first premolar was considered as an unusual variation in the crown that was noticed by ***Nayak et al. 2013*,** as a case report. The maxillary first premolar showed one buccal cusp and two lingual cusps, mesiolingual and distolingual separated by the groove which was extending on to the lingual surface and appeared as a lingual developmental groove. **(fig.5).**

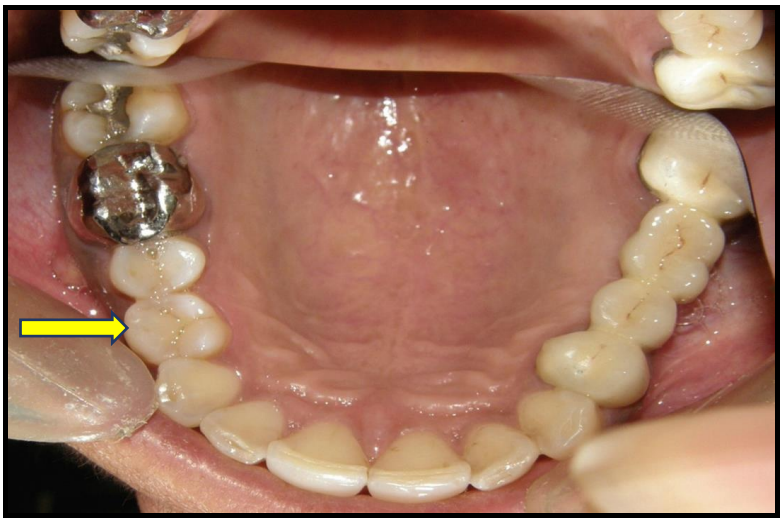

Figure (5): Arrow showing three cusp type of maxillary first premolar ***(Nayak et al., 2013).***

Maxillary second premolars:

There are typically quite symmetrical, which means that the mesial and distal halves are similar in shape. Their occlusal outline is smoother and less angular than the first premolars with an oval outline, thick marginal ridge and contains supplemental grooves but sometimes an accessory or supernumerary cusp was defined by ***Dahlberg*** in ***1945*** as a paramolar tubercle that is developed on the buccal or lingual surfaces of the maxillary and mandibular premolars.

Maxillary second premolars may have an extra cusp on the palatal cusp at its palatal aspect ***(Ngassapa et al., 1996).***

Presence of maxillary second premolar with four cusps; one buccal and one palatal and two small accessory cusps

named as mesiobuccal accessory cusp and distobuccal accessory cusp with lobe like structure and they found only on the buccal surface, not on the occlusal surface. This reported by ***(Parul et al., 2016).*** **(Fig.6).**

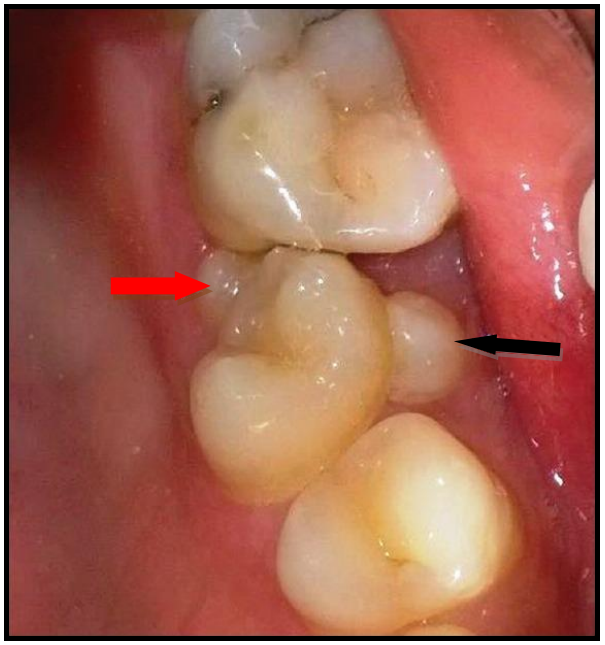

Figure (6): Showing maxillary second premolar with four cusps Black arrow (mesiobucaal cusp) red arrow (distobuccal cusp) ***(Parul et al., 2016).***

Occlusal morphology of mandibular premolars:

There is a vast range of variability in the occlusal morphology of mandibular premolars ***(Kraus and Furr, 1953).*** The occlusal outline of first and second mandibular premolars may be molar formed having three primary cusps or they may be two-cusped having an H-shaped or U-shaped groove configuration. The first mandibular premolars are usually a bicuspid type with the lingual surface presenting a variety of forms and central groove placed lingually. However, second premolars have two forms bicuspid or tricuspid ***(Robert and Biggerstaff, 1969).*** **(Fig.7)**

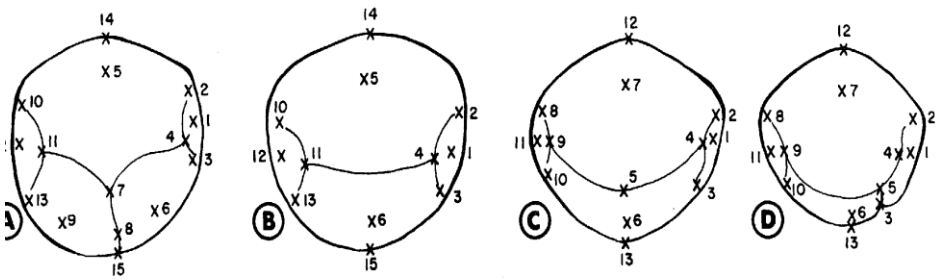

Figure (7): Showing outline of mandibular premolars.
A- Three cusp type of mandibular second premolar.
B- Two cusp type of mandibular second premolar.
C- **& D**- showing mandibular first premolar.
(Robert and Biggerstaff, 1969)

Multiple lingual cusps take different forms on mandibular First Premolar and mandibular Second Premolar. The mandibular premolar may exhibit no lingual cusp or maybe with multiple lingual cusps that are always smaller than the

buccal cusps, this lingual cusp has a mesial placement relative to the buccal cusps ***(Scott, 1973)***.

Scott's Classification of lingual cusps,1973 (Fig.8,9):

Grade 0: no lingual cusp. **(Fig.10)**

Grade 1: single lingual cusp (on a plaque, grade 0-1)

Grade 2: two lingual cusps (on a plaque, grades 2–7)

Grade 3: three lingual cusps (on a plaque, grades 8–9)

Figure (8): Plaque showing lingual cusp number of mandibular first premolar ***(Scott, 1973)*.**

Figure (9): Plaque showing lingual cusp number of mandibular second premolar ***(Scott, 1973).***

Figure (10): The lingual cusp of mandibular first premolar showing grade (0) ***(Scott, 1973)*.**

Mandibular first premolar:

Mandibular first premolars usually have two cusps with triangular ridges and transverse ridge passing between them ***(Ash and Nelson, 2010)***. The variations in the crown morphology of mandibular first premolar have a range from no lingual cusp up to four lingual cusps ***(Rickne and Gabriela, 2011).***

The most common pattern of mandibular first premolars was with one lingual cusp**. Nayak** in **2013** recorded a case report with a mandibular first premolar with a three-cusp pattern with Y- shaped occlusal groove. That has one buccal cusp and two lingual cusps, mesiolingual and distolingual

separated by a lingual developmental groove which was extending on to the lingual surface. **(Fig.11)**

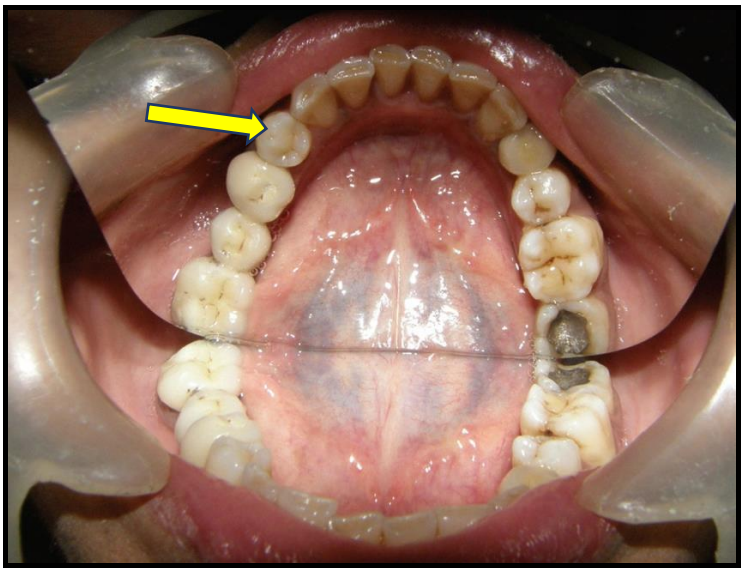

Figure (11): Arrow showing mandibular first premolar with two lingual cusps ***(Nayak, 2013)***

Mandibular second premolar:

They have two forms bicuspid or tricuspid, their lingual cusp may vary from one lingual cusp to a multi-cusps lingual one mesial and two distal smaller than mesial one ***(Scott, 1973)*** **(Fig.13).** Their lingual lobes are more developed than mandibular first premolar making the cusps longer and larger ***(Loh, 1993)***. In the two-cusp type, there are two figures of central groove this may be H-shaped or U-shaped. In three-cusp variety, one buccal cusp and two lingually (mesiolingual cusp is larger than distolingual cusp) and the buccal cusp is the largest ***(Mosharraf et al., 2010).***