Original Article

Analysis of Metric and Morphological Dental Traits in Relatives

Nora Z. Abdella[1], Heba A Yassa[1] , Rana M. Zeidan[2]
Forensic Medicine and Clinical Toxicology, Faculty of Medicine, Assiut University[1]
Faculty of dentistry, Assuit university[2]

Corresponding author:

Heba A Yassa
Hebayassa@aun.edu.eg

ABSTRACT

Background: Teeth can provide evidence about the nature and extent of variation among populations. Teeth are also valuable evidence in living and nonliving populations for anthropological, genetic, odontologic, and forensic investigations. It is known that dental traits are characterized by low sexual dimorphism. This study **aims** to analyze dental traits of permanent teethes within a group of related individuals on the basis of the frequency of dental morphological and metric traits. **Methodology**: 82 adult individuals were grouped according to relation and according to gender. Twenty-six dental morphological traits were scored from prepared dental casts of all individuals. Dental metric data were recorded for 14 bucco-lingual crown dimensions and mesio-distal dimensions. **Results**: The study showed high frequency of tuberculum dentale, carabelli's cusp and four-cusped mandibular second molars. Dental traits with low frequency included winging, interruption groove, congenital absence of incisors, four- cusped mandibular first molars, and six-cusped mandibular first molars. In addition to, statistically significant differences between the related and non-related groups with respect to the frequency of occurrence of the winging, accessory cusps of maxillary second premolars, hypocone, lingual cusp number of mandibular second premolars, anterior fovea, Deflecting wrinkle, Protostylid, groove pattern of mandibular first molars and cusp number of mandibular second molars. Regarding metric traits, the study demonstrated significant difference between means of buccolingual diameter of upper canines, upper second molars and lower first premolars of related and unrelated individuals and mesodistal diameter of upper lateral incisors. **Conclusion:** low frequency traits would be of great value for evaluation of kinships more than the common traits that be of limited value in kinship evaluation while due to their high frequency in different population.

Key words: traits; hypocone; mesio-distal; bucco-lingual

I. INTRODUCTION

Forensic odontology is concerned with the analysis of dental evidence in the legal field. Forensic odontology includes all dental specialties and it is almost impossible to separate one branch from others (Shamim, 2012). Dental anthropology is concerned with the study of dental morphological and metric traits of human populations over time and space and their relation with the processes of adaptation that led to the evolution of the dental system (Moreno et al., 2004). Dentition play an important role in forensics, to identify individuals when usual identification methods are difficult (Marín and Moreno, 2003).

Despite advanced DNA extraction techniques, approaches to kinship that use skeletal morphological data will continue to play an important role because they are non-destructive and unaffected by poor preservation and DNA contamination (Stojanowski and Hubbard, 2017). The biological parameters of the teeth offer good support for the research of human anthropology (Lukacs and Hemphill, 1993). Compared to craniometric measurements, dental traits are more suitable for analysis of kinships as they are not significantly sexually dimorphic, so differences between trait frequencies are not due to only sex, but due to the underlying genetic variation.

Several researches reported that human populations from different geographic regions vary in tooth size, crown and root morphology, and number. Researchers are using dental

morphology to address issues ranging from regional micro-differentiation to global patterns of variation (Scott and Turner, 2003).

There is no standard system to be used in dental morphological analysis. The method to be used vary according to the condition of the teeth, method of observation (in situ, loose, in the living or dead, casts, photography, etc.), and the goal of the analysis. In the anthropological literature; 40 morphological traits were defined and standardized out of more than 100 recognized dental traits (Scott and Turner, 1997). These traits can be described by presence versus absence, by the degree of expression, number, or angle, or as a manifestation of several types of variation. The Arizona State University Dental Anthropology System (ASUDAS) was developed and most commonly used in expression of traits (Turner et al., 1991).

For teeth to be valuable in the evaluation of kinship, dental variables should be under strong genetic control. Although normal dental variation cannot be attributed to only genes, twin and family studies show that metric and morphological traits are highly heritable (Scott and Turner, 2003 and (Hanihara, 2008). In a recent study, Paul and Stojanowski (2015) evaluated the ability of dental morphological traits to identify sets of biological siblings and indicated that biological siblings had smaller inter-individual distances than expected by chance. Therefore, the aim of this study is to analyze dental traits of permanent teeth within a group of related individuals based upon the frequency of dental morphological and metric traits compared to a group of non-related individuals

II. SUBJECT AND METHODS:

Study Design:

Eighty-two subjects (aged 18 to 45 years) were enrolled in the study. Subjects were asked to sign an informed consent to authorize their participation and provided complete genealogical information with complete secrecy. Subjects were grouped according to the relation into related group (40 individuals) and non-related groups (control group 42 individuals). Relatives here mean they are connected through blood, from the same family (parents, siblings, uncles, aunts, grandparents, cousins, nieces and nephews). All data and measurements were taken at the Forensic Medicine Department, Assiut University.

Ethical Aspects:

All ethical aspects were implicated in the study after the approval of the ethical committee, Faculty of Medicine, Assiut University. Confidentiality of participants was considered.

Method:

Alginate impressions were prepared for all subjects shared in the study, by using impression tray for upper and lower palate (Nandini et al., 2008). Then dental stone was poured in each negative impression for making dental casts. All data were collected from dental casts. Twenty-six dental morphological traits were scored according to Arizona State University Dental Anthropology System **(ASUDAS) (Turner et al., 1991).**

Dental metric data were recorded for 14 buccolingual and mesiodistal crown dimensions following the protocol of **Hillson (2005).** Measurements were recorded for all the permanent maxillary and mandibular crowns including; central and lateral incisors, canines, first and second premolars, first and second molars using digital Vernier caliper (Figure 1).

Statistical Analysis:

Statistics analysis was conducted by SPSS (v. 22). The descriptive statistics were reported using mean ± standard deviation (SD), Pearson's correlations, and Paired T test. The statistical significance was set at $P \leq 0.05$ (Nandini et al., 2008).

(Appendix I, the definitions of the trait definitions).

III. RESULTS

A. **morphological dental traits**

There is no statistically significant association between gender and the examined traits except in winging and accessory cusp of maxillary second premolars **(Table 1)**.

Table (1): List of Morphological Dental Traits and Key Tooth and Pearson Correlation of Males and Females Subjects.

N.	Trait	Key tooth (teeth evaluated)	Frequency in males N=37	Frequency in Females N= 45	Total frequency N= 82		Pearson Correlation of males and females subjects
					N	%	
1	Midline diastema (1+)	Maxillary central incisors	10	13	23	28.05%	0.852
2	Winging (3 versus. 1, 2, 4)	Maxillary central incisors	6	0	6	7.32%	0.005**
3	Labial curvature (2+)	Maxillary central incisors	5	5	10	12.19%	0.741
4	Incisor shoveling (2+)	Maxillary central incisors	20	22	42	51.22%	0.641
5	Incisor double shoveling (2+)	Maxillary central incisors	20	18	38	46.34%	0.204
6	Pegged or reduced incisor (1+)	Maxillary lateral incisors	10	10	20	24.39%	0.614
7	Interruption groove	Maxillary lateral incisors	4	4	8	9.76%	0.770
8	Tuberculum dentale (1+)	Maxillary lateral incisors	26	30	56	68.29%	0.727
9	Congenital absence incisora (1+)	Maxillary lateral incisors	2	2	4	4.88%	0.841
10	Canine mesial ridge (1+)	Maxillary canines	3	7	10	12.19%	0.305
11	Distal accessory ridge (1+)	Maxillary canines	13	18	31	37.8%	0.651
12	P3 accessory cusps (1+)	Maxillary first premolars	13	9	22	26.83%	0.124
13	P4 accessory cusps (1+)	Maxillary second premolars	22	13	35	42.68%	0.005**
14	Cusp 5 (1+)	Maxillary first	13	14	27	32.93%	0.700

		molars					
15	Carabelli's cusp (2+)	Maxillary first molars	28	31	59	71.95%	0.496
16	Hypocone (5)	Maxillary second molars	21	28	49	59.76%	0.616
17	Lingual cusp number (2+)	Mandibular second premolars	17	22	39	47.56%	0.791
18	Rotated premolars (1+)	Mandibular second premolars	4	8	12	14.63%	0.374
19	Anterior fovea (2+)	Mandibular first molars	21	20	41	50%	0.267
20	Cusp number (4)	Mandibular first molars	3	9	12	14.63%	0.129
21	Deflecting wrinkle (1+)	Mandibular first molars	8	14	22	26.83%	0.334
22	Distal trigonid crest	Mandibular first molars	7	7	14	17.07%	0.687
23	Protostylid (1+)	Mandibular first molars	10	11	21	25.61%	0.790
24	Cusp 6 (1+)	Mandibular first molars	2	0	2	2.44%	0.114
25	Groove pattern (Y shape)	Mandibular second molars	7	13	20	24.39%	0.295
26	Cusp number (4)	Mandibular second molars	32	34	66	80.49%	0.214

** Highly significant P value ≤ 0.01

The most frequent trait was the four cusped mandibular second molars (80.49%), followed by carabelli's cusp (71.95%), and then fully expressed hypocone (59.76%). The least frequent traits were; cusp 6 (2.44%) and congenital absent incisors (4.88%).

There was a highly significant difference between the two groups in the following traits, (**Table 2)** Carabelli's cusp **(Figure 15)** was shown in 24 (60%) of related subjects while was present in 35 (83.33%) of non-related subjects with p value0.007.Large sized hypocone **(Figure 16)** was shown in 32 (80%) of related subjects while was present 18 (42.86%) of non-related subjects with p value 0.002.Also the mandibular first molars of 12 (30%) of related group and 29 (69.04%) of the non-related group showed a well-developed anterior fovea **(Figure 19)** with p value 0.000. The mandibular first molars showed various degrees of deflecting wrinkle (**Figure 21)** in 5 (12.5%) of related group and in 19 (45.24%) with p value 0.001 While Groove pattern "Y shaped pattern" of mandibular second molar was present in 15 (37.5%) of related subjects and in 4 (9.52%) of non-related group, with p value 0.004 (**Figure 25).** Lastly the cusp number 28 (70%) in related group and 38 (90.48%) in non-related group with p value 0.005. Significant difference between the two groups (related and non-related individuals) also present among the following traits, Winging **(Figure 3)** of upper central incisors was not demonstrated in any subjects of the related group and was present in 6 (14.28%) of subjects in the non-related group with p value0.011.The P4 accessory cusps (2^{nd} premolar) 12 (30%) among the related group and 22 (52.38%) in the non-related individuals, with p value 0.043 **(Figure 13)**. The lingual cusp number 24 (60%) related subjects and 15 (35.71%) of non-related subjects with p value 0.047**(Figure 17)**. Protostylid **(Figure 23)** was present in 5 (12.5%) subjects of the related groups and in 15 (35.71%) of the non-related group with p value 0.01. Other traits with no significant difference between the two groups (related individuals and non-related individuals). (Figure 2, 4 -14, 18, 20 - 24)**.**

Table (2): Frequency of Morphological Dental Traits among Related Subjects and In Non-related subjects.

N	Trait	Frequency				P value
		Related group N= 40		Non-related group N=42		
		N	%	N	%	
1.	Midline diastema (1+)	13	32.5%	10	23.8%	0.461
2.	Winging (3 versus. 1, 2, 4)	0	0%	6	14.28%	0.011*
3.	Labial curvature (2+)	3	7.5%	7	16.66%	0.177
4	Incisor shoveling (2+)	20	50%	21	50%	0.825
5.	Incisor double shoveling (2+)	15	37.5%	23	54.76%	0.076
6.	Pegged or reduced incisor (1+)	11	27.5%	9	21.43%	0.607
7.	Interruption groove (absent versus present)	4	10%	4	9.52%	1
8.	Tuberculum dentale (1+)	29	72.5%	27	64.28%	0.635
9.	Congenital absence incisora (1+)	2	5%	2	4.76%	1
10.	Canine mesial ridge (1+)	7	17.5%	3	7.14%	0.177
11.	Distal accessory ridge (1+)	15	37.5%	17	40.48%	0.651
12.	P3 accessory cusps (1+)	9	22.5%	13	30.95%	0.319
13.	P4 accessory cusps (1+)	12	30%	22	52.38%	0.043*
14	Cusp 5 (1+)	9	22.5%	17	40.48%	0.058
15	Carabelli's cusp (2+)	24	60%	35	83.33%	0.007**
16	Hypocone (5)	32	80%	18	42.86%	0.002**
17	Lingual cusp number (2+)	24	60%	15	35.71%	0.047*
18	Rotated premolars (1+)	4	10%	8	19.04%	0.211
19	Anterior fovea (2+) +1	12	30%	29	69.04%	0.000**
20	Cusp number (4)	3	7.5%	8	19.04%	0.105
21	Deflecting wrinkle (1+)	5	12.5%	19	45.24%	0.001**
22	Distal trigonid crest	5	12.5%	9	21.43%	0.240
23	Protostylid (1+)	5	12.5%	15	35.71%	0.010*
24	Cusp 6 (1+)	2	5%	0	0%	
25	Groove pattern (Y shape)	15	37.5%	4	9.52%	0.004**
26	Cusp number (4)	28	70%	38	90.48%	0.005**

* Significant at P value ≤ 0.05

** Highly significant at P value ≤ 0.01

B-Metric dental traits:

Regarding metric dental traits, the means of mesiodistal and buccolingual dimensions of upper and lower incisors, canines, premolars and molars show no significant difference between males and females as shown in **Table (3)**

Regarding the means of mesiodistal and buccolingual crown dimensions among the related and the non- related Groups **Table (4)** shows that there was highly significant difference between the two groups in the following metric trait, means of upper lateral incisor mesiodistal dimensions (**UI2 MD)** (p value 0.000), means of buccolingual dimensions of upper canines (**UC BL)** (p value 0.002), buccolingual dimensions of first and second molars (**UM1 BL)** and (**UM2 BL)** with p value (0.007 and 0.005 respectively). In addition, there was a statistically significant difference between means of lower second premolar mesiodistaldimensions (**LP4 MD)** with (p value0.016), means of buccolingual dimensions of lower first (**LP3 BL)** and second premolars (**LP4 BL)** with p value (0.021 and 0.025 respectively).

Table (3): Differences between Means of Mesiodistal and Buccolingual Crown Dimensions of Males and Females Using Independent T test

Metric trait	Males Mean ± SD	Females Mean ± SD	P value
UI1 MD	8.69±0.766	8.54±0.747	0.503
UI1 BL	5.22±1.40	5.46±0.954	0.510
UI2 MD	6.80±0.704	6.71±0.688	0.659
UI2 BL	4.85±1.106	4.91±0.799	0.841
UC MD	7.52±0.757	7.30±0.627	0.285
UC BL	6.66±1.160	6.73±1.199	0.842
UP3 MD	6.99±0.592	6.88±0.606	0.520
UP3 BL	8.82±1.255	9.09±0.562	0.357
UP4 MD	6.78±0.553	7.05±0.918	0.229
UP4 BL	9.08±0.802	9.44±0.670	0.125
UM1 MD	10.15±0.699	10.09±0.599	0.765
UM1 BL	10.55±0.847	10.63±0.677	0.732
UM2 MD	10.11±0.897	9.99±0.812	0.655
UM2 BL	10.68±0.809	10.80±0.904	0.632
LI1 MD	5.86±1.454	5.50±0.463	0.283
LI1 BL	4.43±0.859	4.57±0.908	0.579
LI2 MD	5.70±0.720	5.79±0.486	0.626
LI2 BL	4.56±1.543	4.74±0.747	0.606
LC MD	6.50±0.731	6.40±0.538	0.605
LC BL	5.70±0.831	5.89±0.806	0.430
LP3 MD	7.12±0.611	7.15±0.620	0.855
LP3 BL	7.45±0.633	7.63±1.169	0.511
LP4 MD	7.44±0.684	7.41±1.031	0.893
LP4 BL	8.39±0.851	8.13±0.784	0.292
LM1 MD	10.44±1.163	10.48±0.740	0.879
LM1 BL	10.06±0.928	10.03±0.701	0.921
LM2 MD	9.96±0.877	10.09±0.88	0.623
LM2 BL	9.87±0.846	10.01±0.737	0.542

U, upper; L, lower; I, incisor; C, canine; P, premolar; M, molar; BL, buccolingual; MD, mesiodistal, P3 first premolar, P4 second premolar.

Table (4): Differences between Means of Mesiodistal and Buccolingual Crown Dimensions of Related and Non-related subjects Using Independent T test

Metric trait	Related Mean ± SD	Non Related Mean ± SD	P value
UI1 MD	5.51±4.16	6.09±4.11	0.543
UI1 BL	5.59±1.25	5.13±0.88	0.127
UI2 MD	6.40±.74	7.07±0.51	0.000**
UI2 BL	5.06±0.95	4.70±0.79	0.156
UC MD	7.37±0.66	7.41±0.70	0.850
UC BL	7.22±1.14	6.25±0.99	0.002**
UP3 MD	6.85±0.55	7.41±0.70	0.255
UP3 BL	9.17±0.78	8.72±1.03	0.087
UP4 MD	6.93±1.17	7.09±0.85	0.560
UP4 BL	9.55±0.78	9.14±0.76	0.071
UM1 MD	10.07±0.68	10.30±0.79	0.287
UM1 BL	10.99±0.67	10.42±0.77	0.007**
UM2 MD	9.47±0.80	10.00±1.20	0.093
UM2 BL	11.05±0.83	9.84±1.75	0.005**
LI1 MD	3.43±2.56	3.96±2.96	0.380
LI1 BL	2.74±2.10	3.19±2.12	0.368
LI2 MD	5.68±0.99	6.17±0.98	0.080
LI2 BL	4.72±1.34	4.67±0.93	0.880
LC MD	6.47±0.65	6.55±0.56	0.636
LC BL	5.85±0.73	5.88±0.91	0.921
LP3 MD	7.06±0.62	7.32±0.61	0.154
LP3 BL	7.27±0.50	7.85±1.06	0.021*
LP4 MD	7.13±0.73	7.83±1.15	0.016*
LP4 BL	7.98±0.90	8.49±0.61	0.025*
LM1 MD	10.36±1.01	10.53±0.85	0.522
LM1 BL	10.08±0.70	10.05±0.92	0.882
LM2 MD	9.91±0.80	10.27±0.92	0.143
LM2 BL	10.09±0.90	9.79±0.79	0.208

U, upper; L, lower; I, incisor; C, canine; P, premolar; M, molar; BL, buccolingual; MD, mesiodistal, P3 first premolar, P4 second premolar.

Figure 1: digital Vernier caliper

Figure (2): A photograph of dental cast showing Midline diastema of upper central incisors

Figure (3): A photograph of dental cast showing winging of upper central incisors

Figure (4): A photograph of dental cast showing labial curvature of upper central incisors

Figure (5): A photograph of dental cast showing shoveling of upper central incisors

Figure (6): A photograph of dental cast showing Shoveling of double shoveling of Incisors

Figure (7): A photograph of dental cast showing Pegged upper lateral Incisors

Figure (8): A photograph of dental cast showing interruption groove of upper later Incisors

Figure (9): A photograph of dental cast showing tuberculum dentale of upper lateral Incisors

Figure (10): A photograph of dental cast showing congenitally absent upper lateral Incisors

Figure (11): A photograph of dental cast showing canine mesial ridge

Figure (12): A photograph of dental cast showing Canine distal accessory ridge

Figure (13): A photograph of dental cast showing second upper premolar accessory cusp

Figure (14): A photograph of dental cast showing distal accessory cusp (metaconule) of maxillary first molar

Figure (15): A photograph of dental cast showing Carabelli's cusp of maxillary first molar

Figure (16): A photograph of dental cast showing hypocone of maxillary first molar

Figure (17): A photograph of dental cast showing lower premolars with 3 lingual cusps

Figure (18): A photograph of dental cast showing rotated lower second premolar

Figure (19): A photograph of dental cast showing Anterior fovea of mandibular first molar

Figure (20): A photograph of dental cast showing 5 cusped mandibular first molar

Figure (21): A photograph of dental cast showing Deflecting wrinkle mandibular first molar. Notice the 4 cusped second mandibular molar.

Figure (22): A photograph of dental cast showing Distal trigonidcrest of mandibular first molar

Figure (23): A photograph of dental cast showing Protostylid of mandibular first molar

Figure (24): A photograph of dental cast showing 6 cusped mandibular first molar

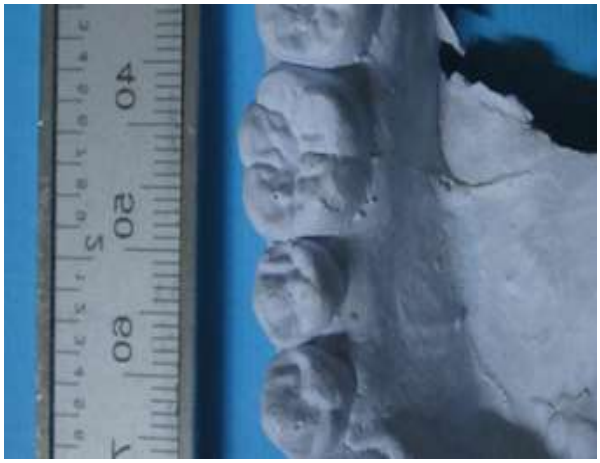

Figure (25): A photograph of dental cast showing Y groove pattern of 5 cusped mandibular first molar

IV DISCUSSION

During forensic and archaeological excavations, not all the bones of an individual are collected. Usually the skull and teeth are the only method for identification **(Vodanovic et al., 2007).** It is generally believed that most morphological dental traits are genetically determined **(Ling and Wong, 2010).** However, environmental factors can affect tooth size, characteristics, and morphology **(Allen et al., 2015).** The aim of this study is to found common dental traits that can be found among relatives, to help in forensic study and disasters.

Midline diastema incidence varies greatly with age group, gender, population, and race. Maxillary midline diastema is postulated to be affected by both environment and genes. A qualitative and quantitative study described dental traits in archaeological Egyptian samples from Roman period revealed that the frequency of midline diastema in Upper Egypt ranged from 0% to 12.1 % **(Irish, 1997).** Saudi study showed that diastema was found to be 13.6% among the screened sample, which were one hundred Saudi patients with midline diastema above 0.5 mm **(Jaija et al., 2016).**The present study showed that midline diastema was present in (32.5%) of related subjects and (23.8%) in non-related subjects. Also, there was no sexual difference of diastema frequency according to gender, and also, no significance difference among related and non-related groups. On contrast to this study, a Baghdadi study showed that females are more common to have a maxillary midline diastema (**Al-Rubayee, 2013).**

Scott and Turner 1997 and Díaz et al., 2014 attributed winging as a frequent trait among the mongoloid population. While, the current study, winging was not demonstrated in any subjects of the related group and was present in (14.28%) of non-related individuals. In addition, it showed high sexual (male) dimorphism with all winging seen.

The current results demonstrated that labial curvature was shown in only (7.5%) of related subjects while was present in (16.66%) of non-related subjects. **Denton, 2011** agreed with the results of this study, reported that labial curvature is more commonly seen in Neanderthals and Mongoloid incisors than Caucasoid**.**

Blanco and Chakraborty (1976) and **(Kimura et al., 2009)** studied shoveling among relatives, and they reported that 68% of total variability could be explained by the effect of genes. **Kimura et al., (2009)**, reported that shovel of upper incisors is common between Native American and Asian but rare or absent between European and African. While, the present study showed that shoveling was detected in (50%) of related subjects and in (50%) of non-related subjects. Incisor double shoveling was detected in (37.5%) of related subjects and in (54.76%) of non-related in the present study. Double shoveling is reported to

be rare trait in certain modern human groups, as reported among European, South African and West Asian **(Bailey, 2006).** A Japanese study showed that double shoveling was more common in females was significantly higher than that in males **(Kimura et al., 2009).**

The frequency distribution of the peg-shaped maxillary lateral incisors reported is variable in different studies; ranged from 0.5% to 3.4%. These may be due to a lack of definite criteria for describing this tooth or it may be a true racial difference **(Ling and Wong, 2008 and Kondo et al., 2014).** The current results demonstrated that Pegged or reduced incisor was showed in (27.5%) of related subjects while was present in (21.43%) of non-related subjects. It is reported to be found more frequently in females than in males (**Min-Kyu, 2017).**

The interruption groove is a trait in the maxillary incisors. In the present studied sample; It was shown in (10%) of related subjects while was present in (9.52%) of non-related subjects. Also, tuberculum dentale was present in (72.5%) of related subjects while was present (64.28%) in non-related subjects. Tuberculum dentale prevalence was 13.35% in Spaniel study **(Pacelli and Márquez-Grant, 2010).** While other study showed that tuberculum, dentale is at the low end of the frequency range **(Scott et al., 2013).** A study from Portugal indicated sexual dimorphism on a 19th century population with a high frequency of over 70% on incisors and 60% on canines **(Galera et al., 2003).**

Most people develop all 32 permanent teeth, but the congenital absence of one or more of permanent teeth is not rare. Second incisors, second premolars, and the third molars can be congenitally absent. The maxillary lateral incisor frequently experience congenital absence **(Mattheeuws et al., 2004)**. The current study showed that the maxillary lateral incisor was congenitally absent in (5%) of related and in (4.76%) of non-related subjects.

In the upper canines, mesiolingual (the mesial ridge) and distolingual marginal ridges are normally equal in size. In rare instances, a strongly developed mesiolingual marginal ridge of the upper canine may fuse with the tuberculum dentale. This feature was first described as the "Bushman canine" due to its high occurrence among the Bushmen and other Sub-Saharan African groups. Bushman canine frequency ranged from zero to 17.7 in Upper Egypt **(Irish, 1997).** This study showed that mesiolingual marginal ridge (Canine mesial ridge) was developed in (17.5%) of related subjects while was present (7.14%) of non-related subjects.

Distal accessory ridge was present in (37.5%) of related subjects while was present (40.48%) of non-related subjects in the current study. It is difficult to record in older individuals where slight attrition obliterate any trace of its occurrence **(Turner et al. 1991).** An expression rate of 20-60% was shown in modern human groups; a higher frequency is seen in Mongoloids and Native Americans with lower frequencies among Europeans **((Danish et al., 2014 and Min-Kyu, 2017).** Distal accessory ridge ranged from zero to 31.8% in Archeological samples from Upper Egypt (**Irish, 1997).** It is the most sexually dimorphic crown trait, more in male than females **(Scott and Turner 1997).** In the present study, no significant difference was recorded between its frequency in males and females.

Dens evaginatus or evaginated odontoma, it occurs as enamel covered tubercle on the occlusal surface and it common among mongoloid race **(Nageow and Chai, 1984 and Levitan and Himel, 2006).** In the current results; accessory cusps of upper premolars were documented in (22.5%) and (30%) in first and second premolars of the related subjects respectively, while in the non-related group; the accessory cusps were present in (30.95%) and (52.38%) of first and second premolars respectively.

Cusp 5, there are mainly four cusps on the occlusal surface of the upper molars **(Scott and Turner 1997).** Cusp 5 (metaconule) in upper first molars is also termed distal accessory tubercle **(Ling and Wong. 2010).** The present results demonstrated that the

expression of Cusp 5 in the maxillary first molars was shown in (22.5%) of related subjects while was present (40.48%) of non-related subjects.

The Carabelli's trait is most commonly observed in European populations with frequencies vary from 50% to 90% **(Laatikanen and Ranta, 1996).** Most studies agree that the Carabelli trait is strongly genetically determined. However, some twins' studies suggest that the heritability of the trait is low. Others postulate that the Carabelli cup trait could be attributed to recessive alleles **(Lauc, 2003).** In this study, Carabelli's cusp was shown in (60%) of related subjects and (83.33%) in non-related subjects.

The occlusal surface of the maxillary second molar is about 13% smaller than that of the first molar and with large protocone and paracone and significantly smaller metacone and hypocone **(Dinh and Harris, 2005).** The metacone and hypocone are reported to be noticeably larger in the black populations **(Harris, 2004).** In this study, hypocone of the maxillary first molar was shown to be of full size in (80%) of related subjects while (42.86%) in non-related subjects.

The key tooth for parastyle is the maxillary third molar that did not erupt in most subjects **(Omal et al., 2013)**. In the current results, Protostylid was present in (12.5%) subjects of the related groups and in (35.71%) of the non-related group. Protostylid is one of "Mongoloid dental complex, **(Hanihara, 1968)** which distinguish populations from South Eastern Asia. **Díaz et al., 2014** agreed with this study as Caucasoid populations characterized by a low frequency of protostylid**.**

Lingual cusp number, although premolars, generally grouped as bicuspids, mandibular premolars do not strictly follow this criteria. Lower premolar is highly variable. One, two or three lingual cusps of varying size are common **(Sunil and Gopaku-mar, 2012).** The proportion of two lingual cusps in the second premolar was much higher in Korean (45.4%) than in Caucasian (26.3%) **(Yoo et al., 2015).** The present results showed that the lower second premolar of (60%) related subjects and (35.71%) of non-related subjects had 2 or more lingual cusps

Rotation of a tooth is a rare anomaly. This anomaly is affected by both local and genetic factors **(Nayak and Inderpreet, 2013).** In this study; the lower second premolars were shown to be rotated along its long axis in (10%) of related subjects while was rotated in (19.04%) of non-related subjects.

Anterior fovea of the lower molars was a frequent trait observed by **Bailey, 2011).** Results documented that the lower first molars of (30%) of the related group and (69.04%) of the non-related group showed a well-developed anterior fovea which is bordered by a pronounced mesial margin.

The present study showed that the mandibular first molars had 4 cusps in (7.5%) of related subjects and (19.04%) in the non-related group, while the mandibular second molars had 4 cusps in (70%) of related subjects and (90.48%) in the non-related group. These results are supported by results of **Gauta et al., (2010)** who reported that first molars with 5 cusps prevail both in the archaeological and modern populations, while the second molars mostly had 4 cusps.

In most literature, it is stated that the mandibular second molar commonly had (+) shaped groove pattern. The formation of "y" or "+" grooves take place regardless of the cusps number. Groove patterns is postulated to be a polygenic trait **(Jordan et al., 1992 and Shetty et al., 2016).** This study showed that the Y groove pattern of second mandibular molars represented (37.5%) of related subjects and (9.52%) of the non-related group.

The deflecting wrinkle was found most frequently between the lower second molars from the recent population (63.6%) **(Wu and Turner, 1993** and **Gauta et al., 2010).** The current study demonstrated that mandibular first molars

Common dental traits are not very useful in the evaluation of kinships because of their high prevalence in certain populations. It was suggested that some dental traits are

constant within a given geographical area or within a population **(Pacelli and Márquez-Gran, 2010).**

Regarding metric traits, the current study demonstrated significant differences between means of buccolingual dimensions of upper canines, upper second molars and lower first premolars of related and unrelated individuals and mesiodistal diameter of upper lateral incisors.

Paulino et al., (2005) found that there is a significant difference in the mesodistal diameter between females and males, being higher in the latter. **Ates et al., (2006)** demonstrated no sexual dimorphism in the mesodistal and buccolingual diameters of teeth in Turks. Also **Castillo et al., (2011)** in a Colombian sample of mixed Caucasians, concluded that the mesodistal and buccolingual diameters are not sexually dimorphic.

V. CONCLUSION

Dental traits with low frequency including winging, interruption groove, congenital absence of incisors, four- cusped mandibular first molars, and six-cusped mandibular first molars, have great value for evaluation of kinships due to their low frequency. The common traits would be of limited value in kinship evaluation; they are of high frequency due to consanguineous marriages in Upper Egypt. All these data can help in identification of relatives in disasters for examples among Upper Egyptian population.

VI. REFERENCES

1. **Allen, KL.; Cooke, SB.; Gonzales, LA. and Kay, RF. (2015):** Dietary Inference from Upper and Lower Molar Morphology in Platyrrhine Primates. PLOS One., 4;10(3):1-22.
2. **Al-Rubayee, MA. (2013):** Median Diastema in a College Students Sample in the Baghdad City. Medical Journal of Babylon, 10(2): 400-406.
3. **Ates, M.; Karaman, F.; Iscan, M. and Erdem, TM. (2006):** Sexual differences in Turkish dentition. Legal Medicine; 8:288-292.
4. **Bailey, S. (2006):** Beyond shovel-shaped incisors: Neandertal dental morphology in a comparative context. Periodicum Biologorum, 108(3): 253-267.
5. **Bailey, SE; Skinner, MM. and Hublin, JJ. (2011):** What lies beneath? An evaluation of lower molar trigonid crest patterns based on both dentine and enamel expression. Am J Phys Anthropol 45:505–518.
6. **Blanco, R. and Chakraborty, R. (1976):** The genetics of shovel shape in maxillary central incisors in man. Am J Phys Anthropol, 44(2): 233-236.
7. **Castillo, L.; Castro, AM.; Lerma, C.; Lozada, D. and Moreno, F. (2011):** Meso-distal and lingual vestibular-lingual diameters of a group of mestizos from Cali, Colombia. Rev Estomat, 19 (2):16-22.
8. **Danish, G.; Hegde, U.; Gehlot, P. and Nabeel, S. (2014):** Dental Cusps: Normal, Supernumerary and Cusp-like Structures — An Overview. Journal of Orofacial Research, 4:161-168.
9. **Denton, CL. (2011):** Shovel-shaped incisors and the morphology of the enamel-dentin junction: an analysis of human upper incisors in three dimensions. Master's Thesis. Colorado State University. Librarie. https://mountainscholar.org/handle/10217/47263, acced in June 2019
10. **Díaz, E.; García, L.; Fernández, M.; Palacio, L.; Ruiz, D. and Velandia, N. (2014):** Frequency and Variability of Dental Morphology in Deciduous and Permanent Dentition of a Nasa Indigenous Group in the Municipality of Morales, Cauca, Colombia. Colomb Med., 45:15-24.
11. **Dinh, D.P. and Harris, E.F. (2005):** A Study of Cusp Base Areas in the Maxillary Permanent Molars of American Whites. Dental Anthropology, 18, 22-29.
12. **Galera, V., Gutiérrez, E., Morena, J. M., Cunha, E., & Fernández, D. (2003):** Tubérculo dental-cúspide talón: La población de Coimbra (Portugal) entre 1839-1936. In M. Aluja, A. Malgosa, & R. Nogués, Anthropología y biodiversidad, 156-161. Bellaterra Ediciones. https://uwe-repository. worktribe.com/output/ 1068322?fbclid= IwAR1ws MEXQkYAjRsLSLsujtOufFjFO _S0QT6lOur0oLUmwcTdCUc_75siyhk
13. **Gauta, I.; Vazdar, M.A. and Vodanovic, M., (2010):** Human Molar Crown Traits in Croatian Medieval and Contemporary Populations. Acta Stomatologica Croatica. 44. 3-16.

14. **Hanihara, K. (1968):** Morphological pattern of the deciduous dentition in the Japanese American hybrids. J Anthropol Soc Nippon, 76:114-121.
15. **Hanihara, T1. (2008):** Morphological variation of major human populations based on nonmetric dental traits. Am J Phys Anthropol.;136(2):169-182
16. **Harris, EF. (2004)**: Dental anthropology Ethnic, A publication of the dental Anthroplogy Association. New York: Alan R Liss. p 5-14.
17. **Hillson, S. (2005):** Teeth, 2nd Edition. New York, Cambridge University Press. pp 257-284
18. **Irish, JD. (1997):** Characteristic High and Low Frequency Dental Traits in Sub-Saharan African Populations. Am J Phys Anthropol., 102:455-467.
19. **Jaija, AM.Z.; El-Beialy, AR. and Mostafa, YA. (2016):** Revisiting the Factors Underlying Maxillary Midline Diastema. Scientifica, 1-5
20. **Jordan, RE.; Abrams, L. and Kraus, BS. (1992):** Kraus's Dental Anatomy and Occlusion. Mosby Inc, St. Louis.1st ed., pp322.
21. **Kimura, R.; Yamaguchi, T.; Takeda, M.; Kondo, O.; Toma, T. Haneji, K.; et al. (2009):** A Common Variation in EDAR Is a Genetic Determinant of Shovel-Shaped Incisors. Am J Hum Genet., 85(4):528-535
22. **Kondo, S.; Townsend, G. and Matsuno, M. (2014):** Morphological variation of the maxillary lateral incisor. Japanese Dental Science Review 50(4):100-107.
23. **Laatikanen, T. and Ranta, R. (1996):** Occurrence of the Carabelli Trait in Twins Discordant or Concordant for Cleft Lip and/or Palate. Acta Odontol Scand 54:365-368
24. **Lauc, T. (2003):** Influence of Inbreeding on the Carabelli Trait in a Human Isolate. Dent. Anthropol., 16:65-72.
25. **Levitan, M.E. and Himel, V.T. (2006):** Dens Evaginatus: Literature Review, Pathophysiology, and Comprehensive Treatment Regimen. Journal of Endodontics. 32(1):1–9.
26. **Ling, JY.K. and Wong, R.K. (2008):** Incisal Morphology of Southern Chinese. The Open Anthropology Journal, 1:19-25.
27. **Ling, JY.K. and Wong, R.K. (2010):** Incisor Winging in Chinese. The Open Anthropology Journal, 3:8-11
28. **Lukacs, JR. and Hemphill, BE. (1993):** Odontometry and Biological Affinity in South Asia: Analysis of Three Ethnic Groups from Northwest India. Hum Biol., 65: 279-325.
29. **Marín, L. and Moreno, F. (2003):** Forensic Odontology: Dental Identification, A case Report. Rev Estomat., 11(2):41-49.
30. **Mattheeuws, N.; Dermaut, L. and Martens, G. (2004):** Has Hypodontia Increased in Caucasians during the 20th century? A meta-analysis. Eur J Orthod., 26:99-103.
31. **Min-Kyu, P. (2017):** A method for studying human teeth excavated in archaeological sites: A focus on recent research sites. Anthropological Notebooks 23 (2): 5–19
32. **Moreno, F.; Moreno, SM.; Díaz, CA.; Bustos, EA. And Rodríguez, JV. (2004):** Prevalence and Variability of Eight Dental Morphological Features in Young People from Three Schools in Cali,, 2002. Colomb Med, 35 (3):16-23.
33. **Nageow, WC. and Chai, WL. (1984**): Dens Evaginatus on A Wisdom Tooth: A Diagnostic Dilemma- Case Report. Australian Dent J., 43(5):328-330.
34. **Nandini V, Venkatesh K, and Nair K (2008):** Alginate impressions: A practical perspective. J Conserv. Dent. 11 (1): 37-41.
35. **Nayak, G. and Inderpreet, S. (2013):** A Variation in Tooth Position-180° Rotated Maxillary Second Premolar. J Clin Diagn Res., 7(8): 1806–1807.
36. **Omal, PM.; Philipose, L.; Mathew, AL.; Nair, SA.; Varghese, AK.; Babu, SS.; et al. (2013):** Parastyle in a Permanent Maxillary First Molar Tooth: A Rare Entity. Journal of Ind. Acd of Oral Med. and Radiology, 25(2)137-140
37. **Pacelli, C.S. and Márquez-Grant, N. (2010):** Evaluation of dental non-metric traits in a medieval population from Ibiza (Spain). Bull Int Assoc Paleodont.; 4(2):16-28.
38. **Paul, K. and Stojanowski, C. (2015):** Performance analysis of deciduous morphology for detecting biological siblings: Deciduous Morphology in Detection of Siblings. Am. J. Phys. Anthropol., 157 (4): 615-629.
39. **Paulino, S.; Paredes-Gallardo, V.; Gandía-Franco, JL. and Cibrián-Ortiz de Anda, RM. (2005):** Evolution of dental arches characteristics in two age groups. RCOE; 10(1):47-54.

40. **Scott, G. (1977):** Classification, Sex Dimorphism, Association and Population Variation of the Canine Distal Accessory Ridge. Human biology. 49. 453-469.
41. **Scott, G. and Turner, II. C G. (2003):** Dental Anthropology. Annual Review of Anthropology. 17. 99-126.
42. **Scott, G.R.; Alberto, A.; Schomberg, R. and Concepcion de lA R. (2013):** 13 Basque dental morphology and the "Eurodont" dental pattern Anthropological Perspectives on Tooth Morphology: Genetics, Evolution, Variation, eds. Scott G.R and Irish D.J. Cambridge University Press. Pp 296-318.
43. **Scott, RG. and Turner CG., (1997):** The Anthropology of Modern Human Teeth. Dental Morphology and its Variation in Recent Human Populations. New York: Cambridge University Press; pp. 382.
44. **Shamim, T. (2012):** Forensic odontology. Journal of the College of Physicians and Surgeons--Pakistan: JCPSP. 22. 240-5.
45. **Shetty, UA.; Shetty, P. and D'Cruz, AM. (2016):** Determination of Cusp Number and Occlusal Groove Pattern in Mandibular Molars: A Preliminary Epidemiological Study in an Indian Population. Journal of Forensic Science and Medicine, 2:98-101.
46. **Stojanowski, M. and Hubbard, AC. (2017):** Sensitivity of Dental Phenotypic Data for the Identification of Biological Relatives: Kinship Identification with Dentition. International Journal of Osteoarchaeology. 27 (5): 813-827
47. **Sunil, S. and Gopakumar, D. (2012):** Prevalence of the two variants of mandibular second premolars in Kerala population. Int. J. Odontostomat., 6(3):375-377.
48. **Turner, II C.G.; Nichol, C.R. and Scott, G. (1991):** Scoring Procedures for Key Morphological Traits of the Permanent Dentition: the Arizona State University Dental Anthropology System. Advances in Dental Anthropology, 24:13-31.
49. **Vodanovic, M.; Demo, Ž.; Njemirovskij, V.; Keros, J. and Brkić, H. (2007):** Odontometrics: A Useful Method for Sex Determination in an Archaeological Skeletal Population?. Journal of Archaeological Science, 34:905-913.
50. **Wu, L. and Turner, II C.G. (1993):** Variation in the frequency and form of the lower permanent molar middletrigonid crest. Am. J. Phys. Anthropol., 91, 245-248.
51. **Yoo, HI.; Park, H.Y. and Kim, SH. (2015):** Occlusal Surface Analysis of Mandibular Premolars in Koreans. Korean J Phys Anthropol., 28(3):145-153.

List of Abbreviations

ASUDAS	The Arizona State University Dental Anthropology System
Y	Y shaped pattern
UI2 MD	upper lateral incisor mesiodistal dimensions
UC BL	buccolingual dimensions upper canines
(UM1 BL) and (UM2 BL)	buccolingual dimensions of first and second molars
LP4 MD	lower second premolar mesiodistaldimensions
LP3 BL	buccolingual dimensions of lower first
LP4 BL	buccolingual dimensions second premolars
U	upper
L	lower
I	incisor
C	canine
P	premolar
M	molar
BL	buccolingual
MD	mesiodistal
P3	first premolar
P4	Second premolar.

تحليل القياسات والصفات الشكلية للأسنان في الأقارب

نوره زيدان عبداللاه١ ، هبــه عطيــه يسي١، رنا محمد زيدان٢
قسم الطب الشرعي والسموم الإكلينيكية ، كلية الطب، جامعة أسيوط١
كلية طب الأسنان ، جامعة أسيوط ٢

يمكن للأسنان أن تقدم دليلا على طبيعة ومدى التباين بين مجموعة من السكان. كما تعتبر ايضا من الأدلة القيمة المستخدمة في التحقيقات الأنثروبولوجية والجينية والطب الشرعي. فمن المعروف أن السمات الشكلية الأسنان لا تتميز بازدواج الشكل بناء علي اختلاف الجنس. **تهدف هذه الدراسة** إلى تحليل صفات الأسنان الدائمة لمجموعة من الأفراد ذوي القرابة على أساس القياسات والصفات الشكلية. تمت الدراسة على عدد ٨٢ من الأفراد البالغين. تم تسجيل ست وعشرون سمة شكلية من قوالب الأسنان المعدة من جميع الأفراد كما تم تسجيل القياسات للأسنان متضمنة البعدين البكولينجوال (الخدي اللساني) والميزوديستال (الأنسي الوحشي) ل ١٤ من أسنان الفك العلوي والسفلي. **النتائج:** أظهرت الدراسة صفات شكلية شائعة مثل الحديبة السنية وحدبة كارابللي والضرس الثاني السفلي ذو أربع شرفات. أما الصفات الشكلية ذات الانتشار المنخفض فتضمنت القواطع المجنحة والميزاب القاطع والغياب الخلقي للقواطع والضرس الأول السفلي ذو أربع شرفات وذو الست شرفات. أظهرت الدراسة اختلافات ذات دلالة إحصائية بين المجموعات ذات القرابة وغير ذات القرابة فيما يتعلق بتكرار القواطع المجنحة والشرفات الزائدة بالضواحك الثانية للفك العلوي والشرفة اللسانية الوحشية وعدد الشرفات اللسانية للضواحك الثنية بالفك السفلي والنقرة الأمامية للضرس الأول بالفك السفلي والبروتوستيلد شكل الميزاب للضرس الأول وعدد الشرفات بالضرس الثاني بالفك السفلي. أما فيما يتعلق بالصفات المترية؛ أوضحت الدراسة وجود اختلاف ذو دلالة إحصائية بين متوسطات البعد البكولينجوال للأنياب العلوية والضروس الثانية العلوية والضواحك الأولى السفلية والبعد والميزوديستال للقواطع الأولى العلوية للأفراد ذوي القرابة وغير ذوي القرابة. **الخلاصة:** خلصت الدراسة الي أن الصفات غير الشائعة ذات قيمة كبيرة لتقييم القرابة من تلك الصفات الشكلية الشائعة التي تعتبر ذات قيمة محدودة في دراسة القرابة وذلك لكثرة تكرارها بين الأفراد من مختلف البيئات.