Original Article

Indian Journal of Forensic Odontology
Volume 10 Number 2, July - December 2017
DOI: http://dx.doi.org/10.21088/ijfo.0974.505X.10217.3

Role of Root Length & Neck Diameter of Teeth in Sex Determination

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Abstract

Aims: The aim of the present study is to evaluate the efficacy of the root length and neck diameter of teeth, a new odontometric parameter in gender determination. *Materials and Method:* 120 anterior teeth from male patients and 120 anterior teeth from female patients of 22 to 80 years of age extracted tooth collected. Root length measured from buccal side, Mesial side, distal side and means of proximal surfaces. Neck diameter measerd from mesiodistally and buco-lingually. Neck circumference measured from bucco-lingual and mesiodistal crest of curvature. Root length, neck diameter and neck circumference compared between male and female. *Results:* Mandibular central incisors of male patient have mesial, distal & mean proximal root length as well as mesiodistal & buccolingual neck diameter and neck circumference measured at mesiodistally was significantly higher than females and Mandibular lateral incisors of male patients have buccal, mesial & mean proximal root length as well as mesiodistal neck diameter and neck circumference measured at buccolingually was significantly higher than females. *Conclusion:* Root length, neck diameter and circumference of Mandibular central and Mandibular lateral incisors are significantly higher in male than females. Mandibular central and Mandibular lateral incisors are important teeth to identify the gender in forensic odontology.Root length, neck diameter and neck circumferences are more stable and valuable odontometric parameter in gender determination in forensic odontology.

Keywords: Female; Forensic Odontology; Male; Neck Diameter; Root Length.

Introduction

Teeth being the central component of masticatory apparatus, acts as an excellent tissue in genetic, odontologic, forensic and anthropological investigations. It is also resistant taphonomic degration compared to bone, which makes them a valuable tool in forensic identification and research. They are resistant to peri- and post-martem degradation, making them ideal for medico-legal investigation, such as in cases of mass fatalities where bodies have been damaged beyond recognition [1]. Each individual's teeth are more or less different: yours will differ wildly to mine – including variations in teeth width or height, thickness or thinness of cementum and dentine or other idiosyncrasies of size and shape. Such features that vary between individuals are called as *nonmetric* features and are not normally measured.

Gender determination is a fundamental issue in forensic anthropology. Gender determination is more reliable if the complete skeleton is available for analysis. But in forensic cases, human skeletal remains are often with conditions like incomplete, not intact, burned, or damaged [2]. Many techniques based on bone and dental remains have been proposed but it is not always possible to implement the techniques on bone and tooth often perfectly preserved.

In previous work, for identification of skeletal remainsand gender determination, forensic

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Received on 24.07.2017, **Accepted on** 17.08.2017

anthropologists used DNA (Deoxyribose Nucleic Acid) studies. DNA is largely widespread that DNA could lead to identification. But DNA analysis has disadvantage that cannot be extracted if skeleton in burned or damaged condition, thus cannot give data on some of the essential parameters of the biological profile [3]. With the lack of DNA analysis, forensic anthropology present with give contributes in identification, particular in gender determination.

Odontomatric is easy and accurate dental technique for determining the gender in the absence of other skeletal elements. The metrical approach to determining the gender is less subjective and more structured where repeated measurements can be taken to minimize error of the obtained results [4]. It is economic, robust, easy-to-use modeling method compared to a neural network, which is quite complicated and time consuming to implement.

Studies had been carried out on teeth since 66 A.D. at the time of Nero and most of them were on crown of the teeth, but little attention is given to the root and neck diameter of the teeth in forensic odontology. The aim of the present study is to evaluate the efficacy of the root length and neck diameter of teeth, a new odontometric parameter in gender determination.

Materials & Methods

120 anterior teeth from male patients and 120 anterior teeth from female patients of 22 to 80 years of age extracted due to periodontal problems were collected from the oral surgery Department of the Government Dental College, Ahmedabad had been included in the study. All the teeth were fixed in 10% formalin and they were group in the 3 sets of different anterior teeth of maxilla and mandible in male and female patients.

Armamentarium used in study includes: Vernier Caliper, Double ended divider, Metal scale, thin thread of 0.25mm.

Method of Root Length Mesurement

A. *Root Length Mesurement Frombuccal Side of Tooth*: Root lengths were determined by measuring distance from crest of curvature of cementoenamel junction to the root apex of teeth.
B. *Root Length Mesurement Frommesial and Diatal Side of Tooth*: Root lengths were determined by measuring distance from crest of curvature of cementoenamel junction to the root apex of teeth.
C. *Root Length Mesurement from Both Proximal Surfaces of Tooth*: Root lengths were determined by mean of proximal surfaces (Measurment from mesial side+distal side/ 2).

Method for Neck Diameter Mesurement

A. *Neck Diameter Mesurement (Mesio-Distally)*: Neck diameter measured from crest of curvature of cementoenamel junction of mesial side to crest of curvature distal side.
B. *Neck Diameter Mesurement (Bucco-Lingually)*: Neck diameter measured from crest of curvature of cementoenamel junction buccal side to crest of curvature lingual side.
C. *Neck Circumference Mesurement (At Bucco-Lingual Crest of Curvature)*: Neck Circumference measured with thin thread encircle the root from crest of curvature of cementoenamel junction at buccal side to crest of curvature lingual side.
D. *Neck Circumference Mesurement (at Mesio-Distal Crest of Curvature)*: Neck Circumference measured with thin thread encircles the root from crest of curvature of cementoenamel junction at mesial side to crest of curvature distal side.

Statastical Analysis

Data were collected and analyzed with SPSS software version 12.0. Two sample independent t test has been performed.

Results

Root length measured from mesial and distal side as well as mean proximal root length of mandibular central incisor is significantly higher in male patients than female. Root length measured from buccal and mesial side as well as mean proximal root length of mandibular lateral incisor is significantly higher in male patients than female.

Mesio-distal neck diameter of mandibular central and lateral incisor is significantly higher in male patients.

Bucco-lingual neck diameter of mandibular central incisor is significantly higher in male patient.

Buccolingual neck diameter of maxillary canine is significantly higher in male patient. Bucco-Lingual Neck circumference of Mandibular Lateral Incisor is

Table 1: Comparison of root length in between male and female

Teeth	Number	Gender	Root Length (Bucal)			Root Length (Mesial)			Root Length(Distal)			Mean Proximal Root Length		
			Mean	SD	p value	mean	SD	p value	mean	SD	p value	mean	SD	p value
MAX	20	M	1.183	0.129	0.394	1.441	0.097	0.498	1.491	0.182	0.587	1.47	0.115	0.979
CEN	20	F	1.25	0.130		1.485	0.115		1.445	0.090		1.468	0.099	
MAX	20	M	1.333	0.177	1	1.583	0.201	0.452	1.535	0.180	0.145	1.556	0.190	0.328
LAT	20	F	1.333	0.122		1.505	0.139		1.395	0.120		1.456	0.143	
MAX	20	M	1.766	0.206	0.890	1.941	0.215	0.893	1.9	0.223	0.747	1.92	0.217	0.828
CAN	20	F	1.751	0.158		1.955	0.100		1.933	0.103		1.941	0.099	
MAND	20	M	1.226	0.206	0.484	1.533	0.153	**0.020**	1.45	0.151	**0.044**	1.496	0.150	**0.030**
CEN	20	F	1.158	0.102		1.328	0.099		1.283	0.093		1.311	0.099	
MAND	20	M	1.283	0.051	**0.002**	1.533	0.136	**0.043**	1.466	0.125	0.117	1.501	0.125	**0.048**
LAT	20	F	1.175	0.041		1.366	0.112		1.333	0.143		1.353	0.101	
MAND	20	M	1.466	0.252	0.900	1.74	0.189	0.896	1.641	0.210	0.721	1.693	0.197	0.802
CAN	20	F	1.45	0.194		1.725	0.201		1.591	0.259		1.661	0.229	

MAX CEN: MAXILLARY CENTRAL INCISOR, **MAX LAT:** MAXILLARY LATERAL INCISOR**MAX CAN:** MAXILLARY CANINE, **MAD CEN:**MANDIBULAR CENTRAL INCISOR, **MAND LAT:**MANDIBULAR CENTRAL INCISOR,**MAND CAN:** MANDIBULAR CANINE, **M:** MALE, **F:** FEMALE

Table 2: Comparison of neck diameter and neck circumference between male and female

Teeth	Number	Gender	Neck Diameter						Neck Circumference					
			Mesio-Distal			Buccal-Lingual			Buccal-Lingual			Mesial-Distal		
			mean	sd	p value	mean	sd	p value	mean	sd	p value	mean	sd	p value
MAX	20	M	0.608	0.086	0.939	0.625	0.068	0.925	1.898	0.130	0.395	2.121	0.226	0.685
CEN	20	F	0.611	0.058		0.621	0.050		1.975	0.166		2.166	0.136	
MAX	20	M	0.501	0.004	0.151	0.595	0.033	0.155	1.696	0.071	0.673	1.805	0.050	0.006
LAT	20	F	0.475	0.041		0.55	0.063		1.666	0.153		1.7	0.054	
MAX	20	M	0.55	0.044	0.515	0.808	0.097	0.048	2.183	0.186	0.334	2.333	0.140	0.0386
CAN	20	F	0.566	0.040		0.696	0.073		2.091	0.120		2.1	0.194	
MAND	20	M	0.403	0.071	0.028	0.6	0.044	0.029	1.533	0.150	0.215	1.608	0.073	0.030
CEN	20	F	0.321	0.031		0.53	0.050		1.433	0.108		1.466	0.116	
MAND	20	M	0.416	0.068	0.055	0.591	0.037	0.156	1.633	0.147	0.023	1.591	0.210	0.791
LAT	20	F	0.35	0.031		0.558	0.037		0.147	0.040		1.566	0.0816	
MAND	20	M	0.491	0.020	0.734	0.725	0.052	0.541	2.043	0.121	0.193	1.93	0.130	0.404
CAN	20	F	0.5	0.054		0.708	0.037		1.95	0.109		2.01	0.155	

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significantly higher in male patient.

Mesio-Distal Neck circumference of Maxillary Lateral incisor, Canine and Mandibular Central Incisor is significantly higher in male patients.

Discussion

Determining the sex of unknown human remains is the important step in the triad of building a dental

profile. Forensic odontology play an important role in establishing the sex of the victims with bodies damaged beyond recognition due to major mass disaster [5]. For Gender discrimination teeth seems to play very significant and essential role. In the past various study was performed regarding differentiations in crown of teeth between both genders, but very few studies had been done on root of the teeth among both genders.

Root and Neck Diameter of Teeth is More Efficient Odontometric Parameter than Crown as

1. Crown is a functional part of the tooth and there are several factors such as mastication, injuries can disturb the structure of the crown.
2. Attrition, abrasion, erosion, caries, trauma affect more of crown structure than the root structure of teeth.
3. In contrast to crown, root is very well protected in the shocket of the alveolar process. And that's why it is least affect to the external stimuli.

Using optical scanner and radiogrammetric measurements on mandibular permanent teeth, sex determination can be done with 80% accuracy by measuring root length and crown diameters [6].

According to Simon et al,2005 the cervical diameters are not affected by wear until most of the crown has been lost, so they have a big advantage for archaeological purposes [7]. Alt et al,1998 reported that the dental neck diameter proved to be more useful than the crown diameter [8]. Garn et al reported root lengths of the permanent teeth are systematically characterized by a degree of sexual dimorphism greater than that for the corresponding crown dimensions of the same teeth. And he also reported that mesio-distal crown size measurements apparently show higher correlations with the root lengths [9].

In the present study, it was found that male patients had higher root length of mandibular central and lateral incisor when compared to female patients. Findings of Mandibular central incisors like mesial, distal & mean proximal root length as well as mesiodistal & buccolingual neck diameter and neck circumference measured at mesiodistally were found significantly ($p \leq 0.05$) higher in Males in comparison to females. For Mandibular lateral incisors findings like buccal, mesial & mean proximal root length as well as mesiodistal neck diameter and neck circumference measured at buccolingually was also found higher in males when compared to females and this difference was found to statistically significant ($p \leq 0.05$).

Above positive findings of this study demonstrates that there is a significant disparity in root morphology (root length, neck diameter and neck circumference) in both genders and this findings can be utilized in gender differentiation.

Conclusion

The advantages in determining sex on the basis of odontometric features are simplicity, speed, and low cost. Root length and neck diameter is significantly higher in male compared to female. So Root and neck of mandibular central incisor and lateral incisor are more stable and valuable odontometric parameter in gender determination in forensic odontology.

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