

# Prediction of Sex from Teeth Linear Dimensions and Indices

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## ABSTRACT

### KEYWORDS

Linear dimensions,  
BL,  
MD,  
Dental indices,  
Sex prediction.

Determination of sex is one of the most important and vital steps in forensic medicine. Sexual dimorphism using odontometric analysis is found to vary in different populations making it necessary to attain values of a specific population which makes identification of person as easy as possible. The present study aims to establish sexual differentiation using dental parameters including dental linear dimensions and indices. Maxillary jaw casts from total of 100 subjects (50 males and 50 females) between ages 17 and 24 years were taken. Mesiodistal (MD) and Buccolingual (BL) dimensions of each tooth of from maxillary jaw cast excluding third molar were measured using precision calipers, dental indices were calculated. Data was collected and statistical analysis was done using SPSS software version 20. Buccolingual dimension was proved to be a better parameter than MD for assessment of gender in case of left central incisor, canines and left first molar. Crown index of right central incisor, second premolars, and left first molars was the best index for sex prediction of most of the teeth.

## Introduction

Tooth parameters are useful methods for sex differentiation from anthropological skeletal remains. Sexual dimorphism in tooth parameters has been studied over the past half-century with odontologists and anthropologists (Lund and Mörnstad, 1999; İşcan and Kedici, 2003; Acharya and Mainali, 2007). Dental features in sex identification can be classified into nonmetric and metric methods. Nonmetric parameters based on the presence or absence of a particular morphological feature; shoveling of incisor, Carabelli cusps, hypocone and protostylid (Ramakrishnan et al., 2015).

Unlike nonmetric features, metrical methods are more structured, less subjective and it can be repeated to validate the obtained results (Bidmos et al., 2010). Linear dimension including mesio-distal and bucco-lingual and dental indices such as crown area crown module and crown index are termed metric features of the teeth (Acharya and Mainali, 2008 and Bakkannavar et al., 2012).

Many studies were conducted to determine the sex dimorphism taking a single tooth, few teeth or a quadrant into consideration. Some studies have chosen either mesiodistal or buccolingual dimensions in sex determination or single index. The present study combined these parameters for better differentiation and prediction of sexual dimorphism.

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## Material and methods:

The present study was conducted on total of 100 subjects, 50 males and 50 females. The study protocol was approved by Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Sohag University. Informed written consent was taken from subjects. Subject's age group was from 17 to 24 years old. Subjects were students' population of Sohag University, Faculty of Medicine. Visible fractures, proximal dental caries, restoration or significant attrition, subjects with braces, removable partial dentures, fixed partial dentures, cleft palate or cleft lip were excluded from the study.

Maxillary jaw casts were performed using Alginate powder, perforated metal maxillary impression tray, spatula and mixing bowl, and dental stone. Precision caliper was used for measuring of linear dimensions for all teeth except third molars.

**Mesiodistal (MD)** is defined as the greatest dimension between the contact points on the approximate surfaces of the crown and was measured with the caliper beaks placed occlusally along the long axis of tooth surface of the crown where it was considered that contact with adjacent teeth would have normally occurred. **Buccolingual (BL)** is defined as the greatest distance between the labial/buccal surface and the lingual surface of the tooth crown was measured with the caliper held at right angles to the MD dimension. Dental indices have been derived from mathematical combinations of linear measurements. **Crown area** is the product of BL and MD dimensions ( $BL \times MD$ ). **Crown module** for each tooth is taken as the average of BL and MD dimensions, i.e.  $(BL + MD)/2$ .

**Crown index** on the other hand, is the ratio of the two linear measurements expressed as percentage, i.e.  $(BL/MD) \times 100$  (Acharya and Mainali, 2008).

## Statistical analysis:

Data was analyzed using SPSS computer program version 20. Data was expressed as median values. The data was tested for normality using Shapiro-Wilk test. The nonparametric Mann-Whitney test and Wilcoxon Signed Ranks test were used for data which was not normally distributed. Receiver operating characteristic (ROC) curve was constructed for optimum cut off points of the studied measures in predicting male gender and the area under the ROC curve value with 95% CI was calculated. Optimal cut-off values were determined; sensitivity, specificity, positive predictive value, negative predictive value were calculated. Logistic regression test was used to determine the role of the studied measures in predicting male gender. A 5% level was chosen as a level of significance in all statistical tests used in the study.

## Results

### *Central incisor*

There was significant statistical increase in median value of right central incisor's (BL, crown area and crown index) and left central incisor (BL, crown area, crown index and crown module) in males than females, see median and p-values in table (1) .

**Table (1):** Comparison of the median values of central incisors dental parameters between males and females (n=100)

Variables	Right central incisor			Left central incisor		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	8.5	8.5	0.523	8.2	8.5	0.111
BL	4.2	4	<0.001*	4.5	3.6	0.003*
Crown area	34.86	32.3	0.045*	38.25	33.25	0.01*
Crown module	6.25	6.15	0.149	6.5	6.25	0.026*
Crown index%	50.6	46.15	0.003*	50	44.44	0.003*

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve, BL, crown area and crown index of the right central incisor had significant predicting value for male gender. Buccolingual dimension, crown area,

crown module and crown index of left central incisor had significant predicting value for male gender, see AUC areas and cut off points in table (2).

**Table (2):** Receiver operating characteristic (ROC) curve of central incisor measures for optimum cutoff points in predicting male gender.

Marker	Right central incisor							Left central incisor						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value
MD	≤7.2	0.54	24	100	100	56.8	0.539	≤7.6	0.59	24	100	100	56.8	0.116
BL	> 4	0.74	60	88	83.3	68.7	<0.001*	> 4	0.668	56	80	73.7	64.5	0.003*
Crown area	>32.3	0.62	68	64	65.4	66.7	0.045*	>36	0.65	52	92	86.7	65.7	0.011*
Crown module	>6.5	0.58	28	100	100	58.1	0.157	>6.52	0.627	40	100	100	62.5	0.03*
Crown index	>53.33	0.67	44	100	100	64.1	0.002*	>47.06	0.672	52	80	72.2	62.5	0.002*

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

### Lateral incisor

There was significant statistical increase in median value of right lateral incisor's (MD, BL, crown area and crown module) and

of left lateral incisor's (MD, BL, crown area, crown module and crown index) in males than females. See median and p-values in table (3).

**Table (3):** Comparison of the median values of lateral incisors dental parameters between males and females (n=100).

Variables	Right lateral incisor			Left lateral incisor		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	6.6	6.3	0.011	6.7	6.2	0.009*
BL	4	3.6	0.003	4.2	3.8	<0.001*
Crown area	26.66	22.8	<0.001	28.14	23.56	<0.001*
Crown module	5.25	4.9	<0.001	5.45	5	<0.001*
Crown index%	57.97	58.33	0.281	62.69	60.56	0.028*

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve, MD, BL, crown area and crown module of right lateral incisor and left lateral incisor had significant predicting value for male gender. Mesiodistal

dimension, BL, crown area, crown module and crown index of left lateral incisor. See AUC areas and cut off points in table (4).

**Table (4):** Receiver operating characteristic (ROC) curve of lateral incisor measures for optimum cut off points in predicting male gender.

Marker	Right lateral incisor							Left lateral incisor						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value
MD	>6	0.646	76	60	65.5	71.4	0.009*	>6.5	0.650	64	84	70	48	0.011*
BL	>3.8	0.672	68	92	89.5	74.2	0.009*	>4	0.768	68	84	72.4	52	<0.001*
Crown area	>24.85	0.750	68	100	100	75.8	<0.001*	>24	0.802	84	76	82.6	60	<0.001*
Crown module	>5.3	0.724	48	100	100	65.8	<0.001*	>5	0.755	76	76	76	52	<0.001*
Crown index	>66.67	0.562	32	92	80	57.5	0.291	>61.29	0.627	64	72	66.7	36	0.026*

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value

## Canines

There was significant statistical increase in median value of right canine's MD, left canine's crown area, crown module in males

than females. There was significant statistical decrease in median value of right canines, BL, crown area and crown index in males than females. See median and p-values in table (5).

**Table (5):** Comparison of the median values of canine dental parameters between males and females (n=100)

Variables	Right canine			Left canine		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	7.3	7	0.001*	7	7	0.107
BL	5	5.5	<0.001*	5.5	5	0.077
Crown area	36	37.8	0.051*	38.4	33	<0.001*
Crown module	6.25	6.2	0.157	6.4	5.9	<0.001*
Crown index%	64.79	78.57	<0.001*	83.1	71.43	0.836

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve MD, BL, crown area and crown index of right canine had significant predicting value for male gender, crown area and crown module of the left

canine had significant predicting value for male gender. See AUC areas and cut off points table in (6).

**Table (6):** Receiver operating characteristic (ROC) curve of canine measures for optimum cut off points in predicting male gender.

Marker	Right canine							Left canine						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value
MD	>7	0.690	68	64	65.4	66.7	0.003	>7.5	0.593	32	100	59.5	32	0.112
BL	≤4.6	0.728	48	100	100	65.8	<0.001*	>5.2	0.602	64	68	65.4	32	0.079
Crown area	≤34.04	0.613	32	100	100	59.5	0.051	>35	0.714	84	68	81	52	0.002*
Crown module	≤7.15	0.581	96	32	58.5	88.9	0.169	>6	0.714	76	76	76	52	0.002*
Crown index	≤64.79	0.779	56	100	100	69.4	<0.001*	>61.64	0.512	84	32	66.7	16	0.839

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

## Premolars

### First premolar

There was statistical significant increase in median value, of left first premolar's MD

and statistical significant decrease in crown index between males and females. See median and p-values in table (7).

**Table (7):** Comparison of the median values of first premolar dental parameters between males and females (n=100).

Variables	Right first premolar			Left first premolar		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	6.5	6.3	0.097	7	7	0.022*
BL	8.5	8.5	0.9	9	8.9	0.076
Crown area	55.04	55.25	0.431	62.1	61	0.118
Crown module	7.5	7.5	0.454	7.95	7.85	0.112
Crown index%	129.33	133.33	0.638	126.58	128.57	0.007*

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve MD and crown index of the left first premolar had significant

predicting value for male gender. See AUC areas and cut off points in table (8).

**Table (8):** Receiver operating characteristic (ROC) curve of first premolar measures for optimum cutoff points in predicting male gender.

Marker	Right first premolar							Left first premolar						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value
MD	>6.7	0.595	48	80	70.6	60.6	0.099	>7.3	0.632	44	100	100	64.1	0.023*
BL	>9	0.507	20	100	100	55.6	0.903	> 9	0.507	20	100	100	55.6	0.903
Crown area	>67.5	0.546	20	100	100	55.6	0.435	>64.8	0.59	48	100	100	65.8	0.147
Crown module	>8.25	0.543	20	100	100	55.6	0.459	>8.1	0.592	48	100	100	65.8	0.139
Crown index	≤129.33	0.527	52	80	72.2	62.5	0.652	≤127.87	0.656	68	72	70.8	69.2	0.006*

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

### Second premolars

There was significant statistical increase in median value of right second premolar's MD, BL, crown area and crown module and

significant decrease in median value of crown index and left second premolar's crown index in males than females. See median and p-values table in (9).

**Table (9):** Comparison of the median values of second premolars dental parameters between males and females (n=100).

Variables	Right second premolar			Left second premolar		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	7	5.4	<0.001*	6.7	6.5	0.317
BL	9.5	9	<0.001*	9.2	9	0.072
Crown area	63.7	47.5	<0.001*	62.78	58.5	0.525
Crown module	8.15	7.25	<0.001*	7.95	7.75	0.524
Crown index%	130.88	157.41	<0.001*	128.57	138.46	0.001*

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant .

By using ROC curve, MD, BL, crown area, crown module and crown index of the right second premolar, crown index of left

second premolar had significant predicting value for male gender. See AUC areas and cut off points in table (10).

**Table (10):** Receiver operating characteristic (ROC) curve of second premolar measures for optimum cut off points in predicting male gender.

Marker	Right second premolar							Left second premolar						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	P-value
MD	>6.2	0.880	76	92	90.5	79.3	<0.001*	>6.59	0.558	52	76	68.4	61.3	0.326
BL	>9.5	0.702	40	92	83.3	60.5	0.001*	≤8.6	0.602	40	100	100	62.5	0.082
Crown area	>54	0.856	84	92	91.3	85.2	<0.001*	>59.31	0.537	64	68	66.7	65.4	0.547
Crown module	>7.5	0.837	84	92	91.3	85.2	<0.001*	>7.85	0.535	64	68	66.7	65.4	0.565
Crown index	≤154.55	0.810	92	56	67.6	87.5	<0.001*	≤133.33	0.686	68	76	73.9	70.4	0.001*

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

## Molars

### First molar

There was statistical significant increase in median value of right first molar's MD, crown area and crown module and significant

decrease in median value of BL and crown index of right first molar and BL of left first molar in male than female See median and p-values in table (11) .

**Table (11):** Comparison of the median values of first molar dental parameters between males and females (n=100).

Variables	Right first molar			Left first molar		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	9.3	9	<0.001	9.4	9.5	0.703
BL	9.9	10	0.004	9.8	10	0.002*
Crown area	91.14	90	0.009	90.25	95	0.381
Crown module	9.55	9.5	0.02	9.5	9.75	0.337
Crown index%	105.26	111.11	<0.001	100	105.26	0.245

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve, MD, BL, crown area, crown module and crown index of right first molar had significant predicting value for male gender. Buccolingual dimension of first

molar had significant predicting value for male gender. See AUC areas and cut off points in table (12).

**Table (12):** Receiver operating characteristic (ROC) curve of first molar measures for optimum cut off points in predicting male gender.

Marker	Right first molar							Left first molar						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value
MD	>9	0.716	76	80	79.2	76.9	0.001	≤8.5	0.522	28	80	58.3	52.6	0.711
BL	≤9.9	0.650	56	72	66.7	62.1	0.007*	≤9.5	0.656	44	92	84.6	62.2	0.005*
Crown area	>90	0.650	60	80	75	66.7	0.008*	≤83.3	0.550	44	92	84.6	62.2	0.405
Crown module	>9.5	0.634	60	80	75	66.7	0.019*	≤9.15	0.555	44	92	84.6	62.2	0.362
Crown index	≤110	0.759	92	68	74.2	89.5	<0.001*	≤101.01	0.566	60	64	62.2	61.5	0.256

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity, AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

## Second molars

There was statistical significant difference in median value of right second molar's MD and BL, statistical significant increase median value right second molar's

crown area, significant decrease in median value of crown index in males than females. See median and p-values in table (13).

**Table (13):** Comparison of the median values of second molars dental parameters between males and females (n=100).

Variables	Right second molar			Left second molar		
	Median		p-value	Median		p-value
	Males (n=50)	Females (n=50)		Males (n=50)	Females (n=50)	
MD	9	9	0.011*	9.3	9	0.412
BL	10	10	<0.001*	10	9.8	0.725
Crown area	91.2	90	0.023	90	90	0.325
Crown module	9.5	9.5	0.134	9.5	9.5	0.325
Crown index%	106.25	111.11	<0.001*	105.26	107.78	0.771

MD: mesiodistal dimension, BL: buccolingual dimension, p-value is calculated by Mann-Whitney U test, p-value <0.05 is statistically significant.

By using ROC curve MD, BL, crown area, and crown index of right second molar had significant predicting value for male

gender. See AUC areas and cut off points in table (14).

**Table (14):** Receiver operating characteristic (ROC) curve of second molar measures for optimum cut off points in predicting male gender.

Marker	Right second molar							Left second molar						
	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value	Cutoff	AUC	Sens (%)	Spec (%)	PPV (%)	NPV (%)	p-value
MD	>9.3	0.646	48	100	100	65.8	0.011	≤9.5	0.546	80	48	60.6	70.6	0.435
BL	≤9.7	0.696	40	100	100	62.5	0.002*	>9	0.519	72	0	41.9	0	0.75
Crown area	>93	0.630	36	100	100	61	0.024*	≤83.7	0.557	40	80	76.9	59.5	0.334
Crown module	>9.65	0.586	40	100	100	62.5	0.149	≤9.15	0.557	40	80	76.9	59.5	0.334
Crown index	≤106.25	0.753	56	100	100	64.1	<0.001*	≤106.38	0.517	72	52	60	65	0.777

MD: mesiodistal dimension, BL: buccolingual dimension, Sens: sensitivity, spec: specificity AUC: area under curve, PPV: positive predictive value, NPV: negative predictive value.

By the use of multiple binary logistic regression analysis and calculation of odds ratio (OR) at confidence interval (CI) 95%, it

had been concluded that the teeth parameter seen in table (15) were the best parameters in predicting of male gender.

**Table (15):** Final model of multiple binary logistic regression analysis about measures predicting of male gender.

Variables	Adjusted OR	p – value	Variables	Adjusted OR	p – value
Right central incisor			Left central incisor		
Crown index	1.11 (1.04 – 1.2)	0.001*	BL	7.49 (1.13 – 49.66)	0.037*
Crown area	1.12 (1.02 – 1.22)	0.018*			
Right lateral incisor			Left lateral incisor		
Crown area	1.26 (1.1 – 1.44)	0.001*	Crown area	1.26 (1.1 – 1.44)	0.001*
Crown area	1.26 (1.1 – 1.44)	0.001*			
Right canine			Left canine		
MD	10.62 (2.94– 38.45)	<0.001*	MD	5.57 (1.08 – 28.81)	0.04*
Crown area	0.89 (0.83 – 0.95)	0.001*			
Right second premolar			Left second premolar		
Crown index	0.93 (0.91 – 0.96)	<0.001*	Crown index	0.96 (0.93 – 0.99)	0.004*
BL	5.34 (2.04 – 13.99)	0.001*	BL	0.39 (0.18 – 0.83)	0.014*
Right first molar			Left first molar		
Crown index	0.89 (0.79– 0.99)	<0.001*	BL	0.33 (0.12– 0.88)	0.027*
Crown area	0.79 (0.7 – 0.89)	0.035*			
Right second molar			Left second molar		
MD	29.11 (6.69 – 126.62)	<0.001*			

OD: odds ratio, \* statistically significant, (CI<sub>95%</sub>): confidence interval, MD: mesiodistal dimension, BL: buccolingual dimension.



## Discussion

Findings of central incisor linear dimensions in the present study were in agreement with the studies done by Srivastava et al. (2014); Sabóia et al. (2013) and Nahidh, (2014) where they proved that sexual dimorphism is more pronounced in (BL) than in (MD) diameters. Zorba et al. (2011) noted that BL dimensions were more dimorphic than (MD) diameters in most populations. In contrast to the current study, Astete et al. (2009) proved that (MD) is better sex predictor.

Lateral incisor results of the current study were in agreement with Kailash et al. (2018) who detected statistical significance differences in BL and MD dimensions of the left and right lateral incisors. In contrast, Babu et al. (2016) and Srinivasprasad et al. (2017) found that lateral incisor dimensions didn't show any statistical significant differences between males and females.

Acharya and Mainali (2007); Omar and Azab (2009); Pereira et al. (2010) Zorba et al. (2011) as well as Staka and Bibmbashi (2013) founded that there was statistical significant differences between males and females in MD and BL dimensions of canines, which correlates with the current study. In contrast, Al-Rifaïy et al. (1997); Da Costa (2012), reported that there were non-significant statistical differences in the measurements of right and left canines between males and females.

Results of premolars in the present study were in agreement with Babu et al. (2016) and Srinivasprasad et al. (2017), who found that the first premolars dimensions had significant degree of sexual dimorphism. On the other hand Kailash et al. (2018) found that there was statistical significant difference in BL and MD dimensions of the left first, right second and left second premolars between males and females.

Preeti et al. (1999); Rai et al. (2007) Ghodosi et al. (2008); Rai et al. (2008); Sonika et al. (2011) and Eboh (2012) found that there was significant degree of sexual dimorphism in right first molar dimensions which correlates with the results of the present study.

The present results came in contrast to Garn et al. (1967a) and Shireen and Ara (2016), who found that the right first molar dimensions didn't show any statistical significant difference between males and females.

On the other hand, the present results showed that the MD parameter of left first molar showed no statistical significant difference between males and females. Similar results were obtained by Suazo et al. (2008); Agnihotri and Sikri (2010); Kumar et al. (2016) and Narang et al. (2015) who found that MD dimension of left first molar had no role in sexual dimorphism.

Second molar findings of the present study were in agreement with Garn et al. (1966) who found that BL dimension showed greater degree of sexual dimorphism compared to MD diameter. The results of the current study were also in agreement with Sharma et al. (2013), who found that the MD dimension of right second molar exhibited greater sexual dimorphism and it was significantly predictive for male gender than BL dimension of the same tooth.

Staka et al. (2016) found that there was statistical significant difference as regard to central incisor indices and they had significant degree of prediction for male gender, this came in agreement with the results of the current study. In contrast to the present study, Introna et al. (1993) found that crown index of right central incisor and crown area only of the central incisors had high predicting value for male gender.

Canines findings of the current study were in agreement with İşcan and Kedici (2003) as

well as Acharya and Mainali (2007), who proved that canine dental indices showed significant degree of sexual dimorphism. In contrast, Lund and Mörnstad (1999) and Karaman (2006) detected that the crown index of canines makes no contribution to sex dimorphism.

Ditch and Rose (1972) founded that right and left first premolars did not show statistical significant difference as regard to crown area or module between males and females. On the other hand, crown index showed significant degree of dimorphism and had significant predicting value for males, which came in agreement with the results of the current study. In contrast Garib and Peck (2006), found that crown index had significant predicting value for females.

Findings of molars in the current study are in agreement with Townsend and Brown, (1979), who noted that there was statistical significant difference in crown index values of first molars. Also in other studies performed by Rosenzweig (1970) and Garn et al. (1967b), the crown index for first molar was greater in females in a North American sample, the differences being statistically significant.

The current results regarding dental indices concluded that crown index presents a picture of sex dimorphism different to crown area, crown module and linear measurements. This was explained by Kondo and Townsend (2004) who found that crown index "indicates the relative size of (MD) and (BL) diameters, it expresses one linear measurement in terms of the other. While male linear dimensions are generally larger than females' in absolute terms, this may not be true when they are taken as a relative measure. Indeed, some consider crown index to be independent of the absolute values of linear dimensions (Rosenzweig, 1970).

The different patterns of sexual dental dimorphism observed between different populations reflect genetic and environmental influences to dental development (Srivastav et al., 2014). There are differences in odontometric features in specific populations, even within the same population in the historical and evolutionary context.

Differences in dimensions of the teeth are due to greater dentine thickness in males as compared to females, as the Y-chromosome increases the mitotic potential of the tooth germ and induces dentinogenesis (Garn et al. (1979) and Vodanovic et al. (2007).

## Conclusion

The present study proved that BL and Crown index are the best parameters for assessment of gender in most of teeth of the upper jaw.

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## التنبؤ بالجنس من الأبعاد الخطية ومعاملات الأسنان

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تحديد الجنس هو أحد أهم الخطوات الحيوية في الطب الشرعي ويعتبر التمييز بين الجنسين عن طريق دراسته و تحليل قياسات الأسنان في مختلف الشعوب من العوامل التي يساعد في التعرف علي خصائص كل شعب وسهولة تمييزه و تهدف هذه الدراسة الي إيجاد طريقه للتمييز بين الجنسين عن طريق معاملات الأسنان بما في ذلك الابعاد والمؤشرات الخطية للأسنان. تم أخذ قوالب للفك العلوي من ١٠٠ شخص (٥٠ ذكور و ٥٠ إناث) تتراوح أعمارهم بين ١٧ و ٢٤ عامًا. تم قياس أبعاد (MD) أسنان الفك العلوي باستثناء ضروس العقل. تم جمع البيانات وأجراء التحليل الإحصائي باستخدام برنامج SPSS Software الإصدار ٢٠. أظهرت الدراسة فروق ذات دلالة إحصائية بين الذكور والإناث في البعد الخطي ومؤشرات الأسنان في القواطع الامامية والانياب والضروس الثاني والثالث، والبعض الآخر لا تظهر فروق ذات دلالة إحصائية في معاملات او مؤشرات الأسنان .