Original

Geomorphometrics of Tooth Size and Arch Dimension Analysis by Conventional Digital Caliper and Digital Stereomicroscope to Establish Standard Norms for the Pakistani Population

Fazal Shahid¹⁾, Mohammad Khursheed Alam¹⁾, Mohd Fadhli Khamis²⁾, Yuma Honda³⁾,
Yoshihiko Sugita³⁾ and Hatsuhiko Maeda³⁾

¹⁾ Orthodontic Unit, School of Dental Science, Universiti Sains Malaysia, Kelantan, Malaysia

²⁾ Forensic Dentistry Unit, School of Dental Science, Universiti Sains Malaysia, Kelantan, Malaysia

³⁾ Department of Oral Pathology, School of Dentistry, Aichi Gakuin University, Nagoya, Japan

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Abstract: In order to establish standard norms for the Pakistani population, we investigated the geomorphometrics of tooth size and arch dimension using a conventional digital caliper (DC) and a digital stereomicroscope (SM). The sample consisted of 128 subjects ranging in age from 18 to 24 years. A total of 44,155 variables were measured. Dental models of each subject for maxillary and mandibular arches were scanned via Hirox digital stereomicroscope for the fabrication of the digital models, and the geomorphometrics of tooth size and arch dimensions were measured via SM scanned digital models. All the measurements were also carried out via DC on plaster dental models. Sex differences and changes associated with methods were assessed, and interrelationships between different variables were explored within the study group. For the data obtained by DC and SM techniques, the men had significantly larger arch dimensions and geomorphometrics of tooth size than the women did. There were no significant disparities observed between the techniques. The developed norms for the mesiodistal, buccolingual, diagonal tooth sizes and arch dimension had significantly greater values for males in relation to females (**p* < 0.05 to ****p* < 0.001). This study has established a new reference database of tooth size and arch dimensions via both DC and digital SM for first time on Pakistani population. These norms will be helpful for clinical treatment planning in dentistry. Contemporaneously, the norms will be of great value to forensic dentists and dental anthropologists for making comparisons within and between different populations.

Key words: Mesiodistal; Buccolingual; Diagonal; Geomorphometric tooth size; Dental arch dimensions; Pakistani; Digital dental models

Introduction

Malocclusion is a common dilemma in all populations. Although the nature of malocclusion varies in different population, but teeth size and arch length inconsistency are considered to be an important etiological factors¹⁾. The teeth size and arch dimension are of preponderant importance in the various dental specialties such as Orthodontics, Prosthodontics, Forensic Dentistry and Dental Anthropology.

Nature has given an ideal balance between the maxillary and mandibular teeth size that should be attained for the ideal occlusion and aesthetics, especially in relation to the finishing phase in orthodontics²⁻⁴⁾. There is obvious population variation in the pattern

and magnitude of sexual dimorphism⁵⁻⁷⁾. Teeth in relation to sexual dimorphism have been of prodigious importance to anthropologists and forensic odontologists as well as the focus of many studies for gender assessment^{8,9)}.

Conventional caliper was used by researchers to investigate tooth dimension, to identify the sexual disparities through mesiodistal^{4,10,11,12)}, buccolingual^{9,10,11,12)} and diagonal crown¹³⁾ diameters of teeth. Geomorphometrics is the quantitative approach that refer to the morphology of an entity depends on landmarks. This technique resolves numerous problems accompanying with out-of-date methods of measurements¹⁴⁾.

The aim of the current study was to investigate the geomorphometrics of teeth size and arch dimension analysis by conventional digital caliper (DC) and a novel techniques by digital stereomicroscope (SM). The geomorphometrics include the mesiodistal, buccolingual, diagonal tooth diameters and arch

Correspondence to: Dr. Mohammad Khursheed Alam, Orthodontic Unit, School of Dental Science, Universiti Sains Malaysia, Kubang Kerian, 16150, Kota Bharu, Kelantan, Malaysia; Phone: +60142926987; Email: dralam@gmail.com , dralam@usm.my

dimension of the maxilla and mandible, correspondingly to reconnoiter the following objectives for the first time in Pakistani population.

- To determine the significant differences in measurements obtained via DC and SM.
- To develop tooth geomorphometric norms using-
 - Mesiodistal crown diameter
 - Buccolingual crown diameter
 - Diagonal crown diameter
- To develop arch dimension norms of maxilla and mandible using DC and SM
- To compare the mesiodistal, buccolingual and diagonal crown diameters of the maxillary and mandibular arch between right and left sides
- To evaluate the amount of sexual dimorphism

Materials and Methods

Subjects

All participants provided their written informed consent. Ethics approval was obtained from the Ethics Committee of the Universiti Sains Malaysia (USM/JEPeM/140376). This study was designed and conducted according to the guidelines of strengthening the Reporting of Observational studies in Epidemiology (STROBE), and we applied the STROBE specification in this manuscript¹⁵⁾.

Sample size calculation

The sample size was calculated at the power of 80 %, alpha 0.05, estimated standard deviation 0.60mm¹⁶⁾, mean difference, biologically meaningful 0.3 mm, and equal sample size were taken by utilizing the PS software¹⁷⁾. The calculated sample size was 64 males and 64 females (m=1). Total 44,155 variables were measured with the following inclusion and exclusion criteria.

Inclusion criteria

- Subjects were from the Pakistani population determined via interviews with mutually paternities and ancestors without any multi-ethnic nuptial.
- Age ranges from 18 to 24
- Subjects with all sound erupted permanent teeth (except third molar), with no history of previous orthodontic treatment.
- Class I incisor relationship according to British Standards Institute
- Class I molar and canine relationship
- No crowding, cross bite and spacing
- Straight profile (identify by examining the profile view)
- no craniofacial anomalies

Exclusion criteria

- Inter proximal caries or restoration
- Missing or supernumerary teeth

- Abnormal size or morphology of teeth
- Teeth wear that affect the tooth size measurement
- Damage casts

Oral examinations were carried out with a vigilant assortment of participants. Cross-examination of subjects was performed to minimize selection bias and error; experienced orthodontist and dentists participated throughout the screening sessions.

Dental impressions of the upper and lower arches of each subject were taken with alginate impression material (Zhermack Orthoprint alginate ISO 1563 –ADA 18 Italy) and poured with dental stone (Type III hard plaster quick stone China). The impressions were poured with dental stone within an hour. The set dental casts were disinfected by immersion with 0.5% sodium hypochlorite for 10 minutes and labeled.

Measurement of tooth size and arch dimensions

These measurements were carried out for tooth size and arch dimension via two methods as below:

Measurement via SM technique

Dental models of each subject for maxillary and mandibular arches were scanned via Hirox digital stereomicroscope (HIROX KH7700 Japan) for the fabrication of the digital models (Fig. 1). Geomorphometrics of tooth size and arch dimensions were carried out via SM scanned digital models. SM was proven as valid¹⁸⁾ and reliable tool for such measurements with the accuracy of 0.1×10^{-6} , while manual and digital sliding caliper can measure with the accuracy 0.01 mm, respectively. The acquisitions of measurements for teeth size and arch dimensions were as the following:

Teeth size measurement for maxillary and mandibular arches

Mesiodistal crown diameter (Fig. 2a)

The mesiodistal crown diameter of the tooth was measured from anatomical contact of one tooth to another on occlusal side perpendicular to the long axis of the teeth^{1,4,11,19,20)}.

Buccolingual crown diameters (Fig. 2b)

Buccolingual crown diameters recorded as the greatest distance between buccal/labial and lingual surfaces perpendicular to the occlusal plane^{11,21)}.

Diagonal diameters (Fig. 2c)

The measurements were taken with morphometric points through the largest distance between the mesiobuccal to distolingual (MBDL) and distobuccal to the mesiolingual (DBML) points of the crown¹³⁾.

Arch dimension for maxillary and mandibular arches^{18,19)}

Arch perimeter (Fig. 3 a1)

The sum of fragmental lines from right and left side of the arch (these segments are starting from the distal contact of the

Figure 1. Fabrication of the digital models (a) Hirox digital stereomicroscope (b) digital models of maxilla and mandible

Figure 3. Arch dimension measurements (a1) arch perimeter (a2) arch length (b) Arch width measurements

molar to the mesial contact point of the canine and continue to the contact point of the central incisors).

Arch Length (Fig. 3 a2)

Transverse line connecting between three points, as from the mesio-buccal cusp tip to the mesio-buccal cusp tip of the opposite side of first permanent molar and the line then protracted from both side anteriorly to the centre point between the central incisors for both the maxillary and mandibular arches.

Arch width (Fig. 3b)

- Inter canine widths were obtained from cusp tip of one side to the opposing side cusp tip.
- Inter 1st premolar and 2nd premolar widths were obtained from buccal cusp tip to the buccal cusp tip of the contralateral side.
- Inter first molar width of the maxillary and mandibular arches were obtained from the mesiobuccal cusp tip of right side to the left side.

Measurement via DC technique

The measurements for teeth size and arch dimension were carried out via DC (Mitutoyo, Japan).

Teeth size

Teeth size measurements were obtained for the mesiodistal^{4,9-11)} (Fig. 4a), buccolingual⁹⁻¹²⁾ (Fig. 4b), and diagonal¹³⁾ (Fig. 5) crown diameters.

Arch dimension

Maxillary and mandibular linear arch dimensions were

Figure 2. Measurement of tooth size (a) mesiodistal crown diameter (b) buccolingual crown diameter (c) diagonal crown diameter

Figure 4. DC measurements (a) Mesiodistal crown diameter (b) Buccolingual crown diameter

Figure 5. Diagonal crown diameter via DC

measured for the arch perimeter (Fig. 6a), arch length (Fig. 6b), and arch widths (Fig. 7) inter canine, inter first and second premolars, and inter first molar area.

Error study

20 % of dental cast were randomly selected for intra observer errors. The time interval between the first and second reading

Figure 6. Arch dimension via DC (a) Arch perimeter (b) Arch length

Figure 7. Arch width measurements via DC

Table 1. DC vs. SM for mesiodistal crown diameters.

Variables*	DC		SM		Mean diff.	95% CI		p
	Mean	SD	Mean	SD		Lower	Upper	
11	8.58	0.49	8.59	0.50	-0.01	-0.13	0.10	.831
12	6.87	0.52	6.88	0.49	0.00	-0.12	0.12	.965
13	7.84	0.48	7.85	0.48	-0.01	-0.13	0.10	.831
14	6.95	0.46	6.96	0.44	-0.01	-0.11	0.10	.885
15	6.69	0.48	6.71	0.48	-0.02	-0.13	0.10	.771
16	10.08	0.61	10.09	0.60	-0.01	-0.16	0.13	.871
17	9.27	0.58	9.27	0.59	-0.01	-0.15	0.13	.897
21	8.53	0.49	8.56	0.50	-0.04	-0.15	0.08	.553
22	6.80	0.50	6.83	0.50	-0.03	-0.15	0.09	.598
23	7.78	0.48	7.81	0.48	-0.04	-0.15	0.08	.526
24	6.98	0.46	7.01	0.45	-0.03	-0.14	0.08	.586
25	6.65	0.49	6.68	0.48	-0.03	-0.14	0.09	.658
26	10.00	0.57	10.04	0.58	-0.04	-0.18	0.10	.568
27	9.28	0.55	9.31	0.56	-0.03	-0.16	0.10	.673
31	5.48	0.37	5.50	0.36	-0.03	-0.11	0.06	.525
32	5.97	0.40	6.00	0.39	-0.03	-0.13	0.06	.502
33	6.89	0.46	6.95	0.45	-0.05	-0.16	0.06	.341
34	6.99	0.42	7.03	0.42	-0.03	-0.13	0.06	.494
35	6.98	0.47	7.02	0.46	-0.03	-0.14	0.08	.545
36	11.09	0.75	11.12	0.74	-0.02	-0.20	0.15	.791
37	9.96	0.82	10.03	0.69	-0.07	-0.25	0.11	.465
41	5.47	0.37	5.48	0.37	-0.01	-0.10	0.08	.829
42	5.94	0.33	5.95	0.34	-0.01	-0.09	0.07	.884
43	6.87	0.43	6.84	0.67	0.03	-0.10	0.16	.657
44	7.02	0.43	7.03	0.42	-0.01	-0.11	0.09	.888
45	6.97	0.46	6.99	0.49	-0.02	-0.13	0.10	.786
46	11.15	0.73	11.15	0.73	0.00	-0.18	0.17	.960
47	10.04	0.70	10.05	0.70	0.00	-0.17	0.16	.956

*FDI notation; DC, digital caliper; SM, hirox digital stereomicroscope; CI, confidence interval; SD, standard deviation; Mean diff., mean differences.

were approximately 2 weeks.

The method error was analyzed by the Dahlberg's formula:

$$ME = (\sum (x_1 - x_2)^2 / 2(28))^{1/2}$$

Where x_1 is the first measurement, x_2 the second measurement and $n=1$ the number of sample repeated²².

Statistical analyses

Descriptive data were verified and analyzed statistically using IBM SPSS Statistics Version 22.0 with significance level set at

5% ($P < 0.05$). An independent samples t-test was used to evaluate differences in sex. The paired sample t test was used to determine differences in teeth size between the right and left side of the maxillary and mandibular arches, and difference in techniques between DC and SM.

Results

Error of the method for DC and SM measurements

The method error was analyzed by the Dahlberg's formula,

Table 2. DC vs. SM for buccolingual crown diameters.

Variables*	DC		SM		Mean diff.	95% CI		p
	Mean	SD	Mean	SD	Lower	Upper		
11	6.55	0.62	6.55	0.62	0.09	-0.15	0.15	.990
12	5.63	0.57	5.65	0.56	-0.02	-0.16	0.11	.735
13	7.52	0.61	7.55	0.59	-0.03	-0.17	0.11	.689
14	8.77	0.56	8.80	0.54	-0.03	-0.16	0.10	.668
15	8.88	0.56	8.89	0.55	-0.01	-0.15	0.12	.839
16	10.80	0.58	10.81	0.58	-0.01	-0.15	0.13	.901
17	10.29	0.72	10.33	0.70	-0.04	-0.21	0.13	.649
21	6.56	0.61	6.56	0.61	0.00	-0.14	0.14	.990
22	5.63	0.56	5.65	0.55	-0.02	-0.16	0.11	.732
23	7.50	0.61	7.53	0.59	-0.03	-0.17	0.12	.710
24	8.78	0.57	8.81	0.55	-0.03	-0.16	0.10	.657
25	8.88	0.55	8.89	0.55	-0.01	-0.14	0.12	.845
26	10.80	0.58	10.81	0.58	-0.01	-0.15	0.13	.881
27	10.21	0.73	10.26	0.72	-0.05	-0.22	0.13	.593
31	5.33	0.47	5.31	0.47	0.01	-0.10	0.12	.843
32	5.46	0.54	5.46	0.54	-0.01	-0.13	0.12	.927
33	6.59	0.58	6.58	0.59	0.01	-0.13	0.15	.873
34	7.34	0.50	7.34	0.51	0.00	-0.12	0.12	.984
35	7.93	0.53	7.91	0.55	0.02	-0.10	0.15	.727
36	10.18	0.54	10.18	0.55	0.00	-0.13	0.13	.994
37	9.64	0.63	9.67	0.62	-0.03	-0.17	0.12	.737
41	5.32	0.47	5.31	0.47	0.01	-0.10	0.12	.815
42	5.44	0.53	5.45	0.53	-0.01	-0.13	0.12	.913
43	6.59	0.54	6.58	0.55	0.02	-0.11	0.14	.816
44	7.34	0.50	7.34	0.51	0.00	-0.12	0.12	.989
45	7.93	0.51	7.90	0.54	0.03	-0.10	0.15	.692
46	10.19	0.51	10.19	0.52	0.00	-0.12	0.12	.981
47	9.55	0.94	9.66	0.51	-0.11	-0.29	0.07	.239

*FDI notation; DC, digital caliper; SM, hirox digital stereomicroscope; CI, confidence interval; SD, standard deviation; Mean diff., mean differences.

Table 3. DC vs. SM for maxillary arch diagonal crown diameters.

Variables*	DC		SM		Mean diff.	95% CI		P
	Mean	SD	Mean	SD		Lower	Upper	
11 MxDDP	8.21	0.49	8.22	0.49	-0.02	-0.13	0.10	.764
11MxDMP	8.22	0.51	8.24	0.50	-0.02	-0.14	0.10	.766
12 MxDDP	6.68	0.50	6.68	0.50	0.00	-0.12	0.12	.998
12 MxDMP	6.61	0.54	6.63	0.53	-0.01	-0.14	0.11	.830
13MxDDP	7.52	0.42	7.54	0.40	-0.03	-0.12	0.07	.610
13MxDMP	7.68	0.47	7.71	0.48	-0.02	-0.13	0.09	.719
14 MxDDP	8.23	0.57	8.25	0.57	-0.02	-0.15	0.12	.809
14 MxDMP	8.03	0.53	8.02	0.54	0.01	-0.12	0.14	.895
15 MxDDP	8.16	0.59	8.18	0.58	-0.02	-0.16	0.12	.771
15 MxDMP	8.14	0.58	8.14	0.58	0.00	-0.13	0.14	.965
16 MxDDP	10.87	0.60	10.88	0.61	-0.01	-0.15	0.14	.919
16 MxDMP	12.32	0.61	12.30	0.64	0.02	-0.13	0.17	.806
17 MxDDP	9.60	0.82	9.63	0.82	-0.03	-0.22	0.16	.765
17MxDMP	10.83	0.98	10.83	0.97	0.00	-0.23	0.23	.974
21 MxDDP	8.18	0.55	8.20	0.55	-0.02	-0.15	0.11	.789
21 MxDMP	8.20	0.57	8.21	0.57	-0.02	-0.15	0.12	.806
22 MxDDP	6.68	0.50	6.68	0.50	0.00	-0.12	0.12	.980
22 MxDMP	6.61	0.54	6.62	0.54	-0.02	-0.14	0.11	.812
23 MxDDP	7.51	0.43	7.54	0.41	-0.03	-0.13	0.07	.590
23 MxDMP	7.68	0.47	7.70	0.48	-0.02	-0.13	0.09	.705
24 MxDDP	8.22	0.59	8.24	0.59	-0.02	-0.16	0.12	.828
24 MxDMP	8.02	0.54	8.01	0.54	0.01	-0.12	0.14	.878
25 MxDDP	8.15	0.59	8.17	0.59	-0.02	-0.16	0.12	.777
25 MxDMP	8.13	0.58	8.13	0.58	0.00	-0.13	0.14	.946
26 MxDDP	10.87	0.60	10.88	0.61	-0.01	-0.15	0.14	.932
26MxDMP	12.31	0.61	12.32	0.61	0.00	-0.15	0.14	.971
27 MxDDP	9.62	0.82	9.60	1.05	0.01	-0.21	0.24	.901
27 MxDMP	10.82	0.98	10.82	0.97	0.00	-0.23	0.23	.979

*FDI notation; DC, digital caliper; SM, hirox digital stereomicroscope; MxDDP, maxillary diagonal distopalatal diameter; MxDMP, maxillary diagonal mesiopalatal diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences.

Table 4. DC vs. SM for the mandibular arch diagonal crown diameters.

Variables*	DC		SM		Mean diff. 95% CI			P
	Mean	SD	Mean	SD		Lower	Upper	
31 MnDDL	5.26	0.45	5.30	0.43	-0.04	-0.15	0.06	.447
31 MnDML	5.17	0.45	5.21	0.45	-0.05	-0.15	0.06	.406
32 MnDDL	5.74	0.43	5.76	0.43	-0.02	-0.12	0.08	.688
32 MnDML	5.69	0.45	5.72	0.44	-0.03	-0.13	0.08	.604
33 MnDDL	6.53	0.45	6.56	0.42	-0.03	-0.14	0.07	.537
33 MnDML	6.75	0.46	6.76	0.45	-0.01	-0.12	0.10	.821
34 MnDDL	6.87	0.43	6.88	0.43	-0.01	-0.11	0.09	.800
34 MnDML	7.18	0.49	7.19	0.48	-0.02	-0.13	0.10	.782
35 MnDDL	7.52	0.51	7.56	0.52	-0.03	-0.16	0.09	.595
35 MnDML	7.68	0.59	7.73	0.59	-0.06	-0.20	0.08	.413
36 MnDDL	11.23	0.61	11.26	0.59	-0.02	-0.17	0.12	.745
36 MnDML	11.70	0.60	11.73	0.58	-0.03	-0.17	0.11	.644
37 MnDDL	10.69	0.73	10.72	0.71	-0.04	-0.21	0.14	.685
37 MnDML	10.83	0.67	10.85	0.67	-0.03	-0.18	0.13	.750
41 MnDDL	5.26	0.45	5.30	0.43	-0.04	-0.15	0.06	.448
41 MnDML	5.17	0.45	5.21	0.45	-0.05	-0.15	0.06	.404
42 MnDDL	5.74	0.43	5.76	0.43	-0.02	-0.12	0.08	.691
42 MnDML	5.69	0.45	5.72	0.44	-0.03	-0.13	0.08	.604
43 MnDDL	6.53	0.45	6.56	0.42	-0.03	-0.14	0.07	.524
43 MnDML	6.75	0.46	6.76	0.45	-0.01	-0.12	0.10	.848
44 MnDDL	6.87	0.43	6.88	0.43	-0.01	-0.11	0.09	.818
44 MnDML	7.18	0.49	7.19	0.48	-0.02	-0.13	0.10	.785
45 MnDDL	7.52	0.51	7.56	0.52	-0.03	-0.16	0.09	.583
45 MnDML	7.68	0.59	7.73	0.59	-0.06	-0.20	0.08	.406
46 MnDDL	11.23	0.61	11.25	0.60	-0.02	-0.16	0.13	.824
46 MnDML	11.75	0.92	11.73	0.58	0.03	-0.16	0.21	.784
47 MnDDL	10.69	0.73	10.72	0.72	-0.03	-0.20	0.14	.736
47 MnDML	10.83	0.67	10.85	0.67	-0.02	-0.18	0.14	.784

*FDI notation; DC, digital caliper; SM, hirox digital stereomicroscope; MnDDL, mandibular diagonal distolingual diameter; MnDML, mandibular diagonal mesiolingual diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences.

Table 5. DC vs. SM for the arch dimensions

Variables	DC		SM		Mean diff. 95% CI			P
	Mean	SD	Mean	SD		Lower	Upper	
UAP	96.24	4.54	96.28	4.66	-0.05	-1.14	1.04	.929
UAL	128.95	5.14	129.09	5.41	-0.14	-1.39	1.11	.828
UICW	35.18	2.30	35.19	2.30	-0.01	-0.56	0.53	.958
UI1PW	42.73	2.65	42.73	2.65	0.00	-0.63	0.63	.993
UI2PW	48.08	2.56	48.08	2.56	0.00	-0.61	0.61	.998
UIMW	53.13	2.62	53.13	2.63	0.00	-0.62	0.62	.996
LAP	89.35	4.63	89.39	4.65	-0.04	-1.14	1.06	.938
LAL	111.58	5.59	110.74	4.62	0.83	-0.38	2.05	.179
LICW	26.67	1.95	26.67	1.95	0.00	-0.47	0.46	.990
LI1PW	35.23	2.33	35.24	2.33	0.00	-0.56	0.55	.994
LI2PW	41.15	2.59	41.16	2.59	0.00	-0.62	0.61	.993
LIMW	45.98	2.52	45.98	2.52	0.00	-0.60	0.59	.993

DC, digital caliper; SM, hirox digital stereomicroscope; UAP, upper arch perimeter; UAL, upper arch length; UICW, upper inter canine width; UI1PW, upper inter first premolar width; UI2PW, upper inter second premolar width; UIMW, upper inter molar width; LAP, lower arch perimeter; LAL, lower arch length; LICW, Lower inter canine width; LI1PW, Lower inter first premolar width; LI2PW, Lower inter second premolar width; LIMW, Lower inter molar width; CI, confidence interval; SD, standard deviation; Mean diff., mean differences.

showed the values of 0.006, 0.007, 0.004, 0.0005 and 0.033 for mesiodistal, buccolingual, and diagonal maxillary, diagonal mandibular and arch dimension respectively via DC. Whereas the SM showed 0.005, 0.004, 0.0109, 0.012, 0.001 for the above

variables respectively.

Inter measurement disparities between DC and SM techniques

Tables 1, 2, 3, 4 and 5 show the comparison of tooth sizes and

Table 6. Mesiodistal crown diameters measurement via DC, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff.	95% CI		P	
	Mean	SD	Mean	SD		Lower	Upper		
11	8.71	0.44	8.43	0.50	0.28	0.13	0.44	.001	***
12	6.96	0.51	6.77	0.51	0.20	0.02	0.37	.026	**
13	7.97	0.45	7.70	0.48	0.27	0.11	0.43	.001	***
14	7.03	0.46	6.87	0.45	0.16	0.01	0.32	.036	*
15	6.74	0.46	6.63	0.50	0.11	-0.05	0.27	.171	
16	10.18	0.68	9.96	0.49	0.22	0.02	0.43	.031	**
17	9.44	0.58	9.06	0.52	0.38	0.20	0.57	.001	***
21	8.69	0.45	8.33	0.46	0.36	0.21	0.51	.001	***
22	6.88	0.50	6.70	0.48	0.17	0.01	0.34	.040	*
23	7.91	0.44	7.62	0.48	0.29	0.14	0.44	.001	***
24	7.06	0.47	6.90	0.44	0.16	0.01	0.31	.041	*
25	6.72	0.46	6.56	0.51	0.16	-0.01	0.32	.058	*
26	10.11	0.61	9.87	0.50	0.24	0.05	0.43	.014	**
27	9.41	0.60	9.13	0.45	0.28	0.09	0.46	.003	**
31	5.48	0.35	5.47	0.39	0.01	-0.11	0.14	.859	
32	6.03	0.41	5.91	0.38	0.12	-0.01	0.25	.076	
33	7.02	0.40	6.74	0.48	0.28	0.13	0.43	.001	***
34	7.02	0.45	6.97	0.39	0.05	-0.09	0.20	.457	
35	7.04	0.45	6.92	0.49	0.12	-0.04	0.28	.138	
36	11.21	0.75	10.96	0.74	0.25	0.00	0.50	.051	*
37	10.15	0.80	9.75	0.79	0.40	0.13	0.67	.004	**
41	5.51	0.34	5.44	0.39	0.07	-0.05	0.19	.269	
42	6.01	0.36	5.86	0.29	0.15	0.04	0.26	.009	**
43	6.99	0.42	6.75	0.41	0.24	0.10	0.38	.001	***
44	7.05	0.44	7.00	0.41	0.05	-0.09	0.19	.493	
45	7.03	0.47	6.90	0.45	0.13	-0.02	0.29	.095	
46	11.28	0.71	10.99	0.73	0.29	0.05	0.54	.018	**
47	10.21	0.70	9.85	0.65	0.37	0.14	0.60	.002	**

*FDI notation; DC, digital caliper; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (**pd" 0.001), (**pd" 0.01) and (*pd" 0.05).

Table 7. Buccolingual crown diameters measurement via DC, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff.	95% CI		p	
	Mean	SD	Mean	SD		Lower	Upper		
11	6.78	0.59	6.28	0.55	0.50	0.31	0.69	.001	***
12	5.81	0.52	5.41	0.55	0.40	0.22	0.58	.001	***
13	7.74	0.60	7.28	0.53	0.46	0.27	0.66	.001	***
14	8.93	0.51	8.59	0.55	0.34	0.16	0.52	.001	***
15	9.01	0.49	8.73	0.60	0.29	0.10	0.47	.003	**
16	10.95	0.50	10.63	0.62	0.33	0.14	0.52	.001	***
17	10.36	0.65	10.22	0.79	0.14	-0.10	0.38	.263	
21	6.79	0.56	6.29	0.54	0.50	0.32	0.69	.001	***
22	5.80	0.55	5.43	0.52	0.37	0.19	0.55	.001	***
23	7.73	0.55	7.23	0.57	0.50	0.31	0.69	.001	***
24	8.91	0.54	8.62	0.57	0.28	0.10	0.47	.003	**
25	9.00	0.47	8.74	0.61	0.26	0.08	0.44	.005	**
26	10.95	0.49	10.63	0.64	0.32	0.13	0.51	.001	***
27	10.35	0.73	10.06	0.72	0.29	0.04	0.53	.021	*
31	5.44	0.44	5.19	0.47	0.25	0.10	0.40	.001	***
32	5.55	0.47	5.35	0.59	0.21	0.03	0.39	.024	*
33	6.75	0.58	6.42	0.53	0.33	0.15	0.52	.001	***
34	7.44	0.49	7.23	0.49	0.21	0.05	0.38	.012	*
35	7.97	0.46	7.89	0.60	0.08	-0.10	0.26	.373	
36	10.30	0.55	10.04	0.50	0.25	0.08	0.43	.005	**
37	9.80	0.56	9.46	0.67	0.34	0.14	0.55	.001	***
41	5.43	0.43	5.19	0.48	0.25	0.09	0.40	.002	**
42	5.54	0.48	5.33	0.57	0.21	0.03	0.38	.021	*
43	6.73	0.55	6.44	0.48	0.29	0.11	0.46	.001	***
44	7.42	0.48	7.24	0.51	0.18	0.01	0.35	.036	*
45	7.98	0.48	7.86	0.55	0.12	-0.05	0.30	.158	
46	10.28	0.55	10.09	0.44	0.20	0.03	0.37	.024	*
47	9.62	1.13	9.46	0.67	0.16	-0.16	0.48	.317	

*FDI notation; DC, digital caliper; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (**pd" 0.001), (**pd" 0.01) and (*pd" 0.05).

Table 8. Maxillary teeth diagonal crown diameters measurement via DC, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff.	95% CI		P	
	Mean	SD	Mean	SD		Lower	Upper		
11 MxDDP	8.36	0.44	8.03	0.50	0.33	0.17	0.48	.001	***
11MxDMP	8.38	0.50	8.04	0.45	0.34	0.18	0.50	.001	***
12 MxDDP	6.74	0.46	6.61	0.53	0.13	-0.04	0.29	.134	
12 MxDMP	6.67	0.53	6.54	0.55	0.14	-0.05	0.32	.143	
13MxDDP	7.66	0.37	7.35	0.41	0.31	0.18	0.44	.001	***
13MxDMP	7.83	0.43	7.51	0.46	0.32	0.17	0.47	.001	***
14 MxDDP	8.35	0.57	8.09	0.55	0.25	0.06	0.44	.009	**
14 MxDMP	8.18	0.51	7.86	0.52	0.32	0.14	0.49	.001	***
15 MxDDP	8.29	0.52	8.00	0.62	0.29	0.09	0.48	.004	**
15 MxDMP	8.31	0.52	7.95	0.59	0.36	0.17	0.54	.001	***
16 MxDDP	11.01	0.57	10.72	0.61	0.29	0.09	0.49	.005	**
16 MxDMP	12.45	0.62	12.17	0.57	0.28	0.08	0.48	.007	**
17 MxDDP	9.58	0.85	9.63	0.79	-0.05	-0.33	0.23	.712	
17MxDMP	10.86	1.04	10.78	0.91	0.08	-0.25	0.41	.644	
21 MxDDP	8.31	0.56	8.03	0.50	0.29	0.11	0.47	.002	**
21 MxDMP	8.33	0.63	8.04	0.45	0.29	0.10	0.48	.003	**
22 MxDDP	6.74	0.46	6.61	0.53	0.13	-0.04	0.29	.137	
22 MxDMP	6.66	0.54	6.54	0.55	0.12	-0.06	0.31	.182	
23 MxDDP	7.65	0.39	7.35	0.41	0.30	0.16	0.43	.001	***
23 MxDMP	7.82	0.44	7.51	0.46	0.31	0.16	0.46	.001	***
24 MxDDP	8.33	0.61	8.09	0.55	0.23	0.04	0.43	.020	**
24 MxDMP	8.16	0.51	7.86	0.52	0.30	0.12	0.47	.001	***
25 MxDDP	8.28	0.53	8.00	0.62	0.28	0.09	0.48	.005	**
25 MxDMP	8.29	0.52	7.95	0.59	0.34	0.15	0.53	.001	***
26 MxDDP	11.01	0.57	10.72	0.61	0.29	0.09	0.49	.005	**
26MxDMP	12.44	0.62	12.17	0.57	0.27	0.07	0.48	.009	**
27 MxDDP	9.60	0.85	9.63	0.79	-0.03	-0.31	0.25	.842	

*FDI notation; DC, digital caliper; MxDDP, maxillary diagonal distopalatal diameter; MxDMP, maxillary diagonal mesiopalatal diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (***)p<0.001, (**)p<0.01 and (*)p<0.05).

Table 9. Mandibular teeth diagonal crown diameters measurement via DC Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff.	95% CI		P	
	Mean	SD	Mean	SD		Lower	Upper		
31 MnDDL	5.31	0.35	5.20	0.55	0.11	-0.04	0.26	.160	
31 MnDML	5.21	0.34	5.12	0.55	0.10	-0.06	0.25	.217	
32 MnDDL	5.81	0.40	5.66	0.46	0.15	0.01	0.30	.038	
32 MnDML	5.75	0.41	5.62	0.48	0.13	-0.02	0.28	.095	
33 MnDDL	6.65	0.36	6.38	0.50	0.27	0.13	0.42	.001	***
33 MnDML	6.88	0.40	6.60	0.48	0.28	0.14	0.43	.001	***
34 MnDDL	6.93	0.39	6.80	0.46	0.13	-0.01	0.27	.079	
34 MnDML	7.30	0.43	7.04	0.51	0.26	0.10	0.42	.002	**
35 MnDDL	7.60	0.46	7.43	0.55	0.17	0.00	0.34	.048	*
35 MnDML	7.83	0.50	7.50	0.64	0.34	0.14	0.53	.001	***
36 MnDDL	11.39	0.57	11.06	0.60	0.33	0.13	0.52	.001	***
36 MnDML	11.85	0.57	11.51	0.59	0.34	0.15	0.54	.001	***
37 MnDDL	10.90	0.70	10.43	0.67	0.47	0.24	0.70	.001	***
37 MnDML	10.97	0.65	10.66	0.65	0.31	0.09	0.53	.006	**
41 MnDDL	5.31	0.35	5.20	0.54	0.11	-0.04	0.26	.162	
41 MnDML	5.21	0.34	5.11	0.55	0.10	-0.06	0.25	.215	
42 MnDDL	5.81	0.40	5.66	0.46	0.15	0.01	0.30	.037	*
42 MnDML	5.75	0.41	5.62	0.48	0.13	-0.02	0.28	.093	
43 MnDDL	6.65	0.36	6.38	0.50	0.28	0.13	0.42	.001	***
43 MnDML	6.88	0.40	6.60	0.48	0.28	0.13	0.43	.001	***
44 MnDDL	6.93	0.39	6.80	0.46	0.13	-0.02	0.27	.081	
44 MnDML	7.30	0.43	7.04	0.51	0.26	0.10	0.42	.002	***
45 MnDDL	7.60	0.46	7.43	0.55	0.17	0.00	0.34	.048	*
45 MnDML	7.83	0.50	7.50	0.64	0.34	0.14	0.53	.001	***
46 MnDDL	11.39	0.57	11.06	0.60	0.33	0.13	0.52	.001	***
46 MnDML	11.96	1.09	11.51	0.59	0.45	0.15	0.75	.004	**
47 MnDDL	10.90	0.70	10.43	0.67	0.47	0.24	0.70	.001	***

*FDI notation; DC, digital caliper; MnDDL, mandibular diagonal distolingual diameter; MnDML, mandibular diagonal distolingual diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (***)p<0.001, (**)p<0.01 and (*)p<0.05).

Table 10. Maxillary and mandibular arch dimension measurement via DC Norms and Inter sex disparities.

Variables	Male		Female		Mean diff. 95% CI		P	
	Mean	SD	Mean	SD	Lower	Upper		
UAP	97.52	4.54	94.75	4.08	2.77	1.31	4.23	.001 ***
UAL	130.42	4.49	127.26	5.36	3.17	1.51	4.82	.001 ***
UICW	35.99	1.94	34.24	2.34	1.75	1.03	2.47	.001 ***
UI1PW	43.37	2.06	41.99	3.06	1.38	0.51	2.24	.002 **
UI2PW	48.97	2.31	47.04	2.45	1.94	1.13	2.74	.001 ***
UIMW	53.97	2.58	52.16	2.34	1.81	0.98	2.65	.001 ***
LAP	90.61	4.97	87.88	3.73	2.73	1.23	4.23	.001 ***
LAL	112.94	5.65	109.99	5.12	2.95	1.12	4.78	.002 **
LICW	27.05	2.00	26.23	1.82	0.82	0.17	1.47	.014 *
LI1PW	35.88	1.94	34.49	2.53	1.40	0.64	2.15	.001 ***
LI2PW	41.78	2.47	40.43	2.57	1.35	0.50	2.20	.002 **
LIMW	46.70	2.44	45.15	2.36	1.54	0.73	2.35	.001 ***

DC, digital caliper; UAP, upper arch perimeter; UAL, upper arch length; UICW, upper inter canine width; UI1PW, upper inter first premolar width; UI2PW, upper inter second premolar width; UIMW, upper inter molar width; LAP, lower arch perimeter; LAL, lower arch length; LICW, Lower inter canine width; LI1PW, Lower inter first premolar width; LI2PW, Lower inter second premolar width; LIMW, Lower inter molar width; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (**pd" 0.001), (**pd" 0.01) and (*pd" 0.05).

Table 11. Mesiodistal measurement via SM, Norms and Inter sexes disparities.

Variables* Male	Female		Mean diff. 95% CI		P				
	Mean	SD	Mean	SD	Lower	Upper			
11	8.72	0.44	8.44	0.51	0.28	0.12	0.44	.001	***
12	6.96	0.50	6.77	0.47	0.19	0.03	0.36	.022	*
13	7.98	0.45	7.71	0.48	0.27	0.11	0.42	.001	***
14	7.05	0.45	6.86	0.41	0.18	0.04	0.33	.014	*
15	6.76	0.46	6.65	0.49	0.11	-0.05	0.27	.183	
16	10.20	0.68	9.97	0.48	0.23	0.03	0.43	.027	*
17	9.46	0.58	9.06	0.52	0.40	0.21	0.58	.001	***
21	8.73	0.45	8.37	0.50	0.35	0.19	0.51	.001	***
22	6.91	0.51	6.73	0.47	0.18	0.02	0.35	.032	*
23	7.95	0.43	7.66	0.49	0.29	0.13	0.44	.001	***
24	7.09	0.46	6.92	0.41	0.17	0.03	0.32	.022	*
25	6.75	0.46	6.59	0.48	0.16	0.00	0.32	.046	*
26	10.15	0.60	9.92	0.52	0.23	0.04	0.42	.018	*
27	9.46	0.59	9.14	0.46	0.31	0.13	0.49	.001	***
31	5.52	0.34	5.49	0.39	0.03	-0.10	0.15	.681	
32	6.06	0.40	5.93	0.38	0.13	0.00	0.26	.056	*
33	7.06	0.40	6.82	0.48	0.24	0.09	0.38	.002	**
34	7.05	0.44	7.00	0.40	0.05	-0.09	0.20	.448	
35	7.07	0.45	6.95	0.46	0.12	-0.04	0.27	.138	
36	11.24	0.74	10.98	0.72	0.26	0.01	0.51	.039	*
37	10.22	0.66	9.81	0.66	0.41	0.19	0.63	.001	***
41	5.51	0.34	5.45	0.40	0.06	-0.06	0.18	.341	
42	6.02	0.36	5.87	0.30	0.15	0.03	0.26	.011	**
43	6.99	0.42	6.67	0.85	0.32	0.10	0.54	.005	**
44	7.06	0.44	7.00	0.39	0.06	-0.08	0.20	.398	
45	7.04	0.47	6.92	0.51	0.11	-0.05	0.28	.176	
46	11.29	0.71	10.99	0.71	0.29	0.05	0.54	.017	*
47	10.22	0.70	9.85	0.66	0.37	0.14	0.60	.002	**

*FDI notation; SM, hirox digital stereomicroscope; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (**pd" 0.001), (**pd" 0.01) and (*pd" 0.05).

arch dimension data between DC and SM techniques. There were no significant disparities observed between the both techniques.

Teeth size and arch dimension norms and inter sex disparities

Tables 6, 7, 8, 9 and 10, and Tables 11, 12, 13, 14 and 15 show tooth size and arch dimensions comparisons between males

and females for DC and SM techniques. The developed norms for the mesiodistal, buccolingual, diagonal maxillary, diagonal mandibular and arch dimension respectively with significantly greater values for males in relation to females (*pd" 0.05 to ***pd" 0.001).

Table 12. Buccolingual crown dimension measurement via SM, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff. 95% CI		P	
	Mean	SD	Mean	SD		Lower	Upper	
11	6.78	0.59	6.27	0.55	0.51	0.32	0.70	.001 ***
12	5.82	0.52	5.45	0.55	0.37	0.19	0.55	.001 ***
13	7.75	0.60	7.33	0.50	0.42	0.23	0.60	.001 ***
14	8.94	0.52	8.65	0.52	0.29	0.11	0.47	.001 ***
15	9.02	0.49	8.75	0.59	0.27	0.09	0.45	.004 **
16	10.96	0.51	10.64	0.62	0.32	0.13	0.51	.001 ***
17	10.36	0.65	10.30	0.76	0.07	-0.17	0.30	.587
21	6.79	0.57	6.28	0.54	0.50	0.32	0.69	.001 ***
22	5.80	0.55	5.47	0.51	0.33	0.15	0.51	.001 ***
23	7.74	0.55	7.29	0.55	0.45	0.27	0.64	.001 ***
24	8.92	0.55	8.68	0.53	0.24	0.06	0.42	.011 *
25	9.01	0.47	8.76	0.60	0.25	0.07	0.43	.008 **
26	10.96	0.49	10.64	0.63	0.31	0.12	0.50	.001 ***
27	10.34	0.71	10.17	0.71	0.16	-0.08	0.41	.179
31	5.45	0.43	5.16	0.47	0.29	0.14	0.44	.001 ***
32	5.56	0.47	5.36	0.59	0.20	0.02	0.38	.029 *
33	6.76	0.58	6.38	0.54	0.38	0.19	0.57	.001 ***
34	7.44	0.50	7.22	0.50	0.22	0.05	0.39	.010 **
35	7.98	0.46	7.83	0.63	0.15	-0.03	0.34	.105
36	10.30	0.55	10.04	0.51	0.26	0.08	0.45	.004 **
37	9.81	0.56	9.50	0.64	0.31	0.11	0.52	.002 **
41	5.44	0.43	5.15	0.48	0.29	0.13	0.44	.001 ***
42	5.55	0.48	5.34	0.57	0.21	0.03	0.38	.021 **
43	6.73	0.55	6.40	0.49	0.33	0.16	0.51	.001 ***
44	7.43	0.48	7.24	0.52	0.19	0.02	0.36	.029 *
45	7.99	0.48	7.80	0.58	0.19	0.01	0.37	.038 *
46	10.29	0.55	10.08	0.46	0.21	0.04	0.38	.017 *
47	9.75	0.51	9.55	0.48	0.21	0.04	0.38	.016 **

*FDI notation; SM, hirox digital stereomicroscope; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (**pd" 0.001), (*pd" 0.01) and (*pd" 0.05).

Teeth size comparison sides disparities for the maxillary and mandibular teeth.

Disparities between the right and left side for the mesiodistal, buccolingual, diagonal maxillary and mandibular teeth size respectively. Most of the variables demonstrated no significant differences, except for the few variables (Maxillary lateral incisor [0.047], canine [0.026] and first premolar [0.01] and Mandibular lateral incisor [0.008]) of the mesiodistal tooth size (*pd" 0.05 to **pd" 0.01).

Discussion

Teeth size has been extensively deliberated by means of ordinary morphometric technique. Progresses in digital acquisitions and scanning have relieved the route to captivate such measurements, and have furthermore made it promising to record the location of landmarks as structured. Some scholars have used these thoughts to study teeth size in two-dimensional (x, y) directs from a photographic acquisition^{23,24}. Benefits of geomorphometrics have been utilized to evaluate and look out the effect of different types of mechanics on the treatment of class II division 1 malocclusion^{25,26}. Size and shape of human molars were also investigated, analyzed and compared via traditional and innovative geomorphometrics techniques; in addition to that the dental arch

shapes were also investigated by the same techniques^{26,27}.

Several studies in relation to teeth size; mesiodistal²⁸⁻³¹ buccolingual³² and arch dimension^{28,33,34} has been done on the Pakistani population by sliding caliper but no one used the diagonal teeth dimension and digital models for such investigations²⁸⁻³¹. The current study demonstrated the mesiodistal, buccolingual, diagonal maxillary, diagonal mandibular and arch dimension via conventional DC and for the very first time through a new SM digital models technique.

There were no significant differences observed in the data acquisition via both suggested methods. Our study provided the odontometric norms for teeth size and arch dimension of the maxilla and mandible. Teeth size and arch dimension also showed sexual disparities with the males showed the greater values for all measurements. The current study revealed significant sexual disparities for the mesiodistal tooth width are in accordance with other studies³⁵⁻³⁷. However, some other studies have reported no sexual disparities for mesiodistal tooth width³⁸⁻⁴¹.

In relation to mesiodistal and buccolingual crown diameters, current study showed sexual disparities, which is consistent with published studies for various ethnic groups^{9,11,42-45,46}. Current study showed norms for diagonal crown diameters where male teeth were larger than female. Our results are in agreement with various

Table 13. Maxillary arch diagonal crown dimension measurement via SM, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff. 95% CI		P	
	Mean	SD	Mean	SD	Lower	Upper		
11 MxDDP	8.36	0.44	8.06	0.50	0.30	0.14	0.46	.001 ***
11MxDMP	8.39	0.50	8.07	0.45	0.31	0.15	0.47	.001 ***
12 MxDDP	6.74	0.46	6.61	0.53	0.13	-0.04	0.30	.122
12 MxDMP	6.68	0.53	6.57	0.53	0.11	-0.07	0.29	.225
13MxDDP	7.66	0.37	7.40	0.38	0.26	0.14	0.39	.001 ***
13MxDMP	7.84	0.43	7.55	0.48	0.28	0.13	0.44	.001 ***
14 MxDDP	8.35	0.57	8.12	0.55	0.23	0.04	0.42	.018 **
14 MxDMP	8.18	0.51	7.84	0.52	0.35	0.17	0.52	.001 ***
15 MxDDP	8.29	0.52	8.04	0.62	0.25	0.06	0.45	.010 **
15 MxDMP	8.31	0.52	7.94	0.59	0.37	0.19	0.56	.001 ***
16 MxDDP	11.01	0.58	10.73	0.61	0.28	0.08	0.48	.006 **
16 MxDMP	12.41	0.68	12.17	0.57	0.25	0.03	0.46	.025 **
17 MxDDP	9.59	0.85	9.69	0.78	-0.10	-0.38	0.18	.469
17MxDMP	10.87	1.04	10.78	0.90	0.08	-0.25	0.41	.618
21 MxDDP	8.32	0.56	8.06	0.50	0.26	0.08	0.44	.005 **
21 MxDMP	8.34	0.63	8.07	0.45	0.26	0.08	0.45	.006 **
22 MxDDP	6.74	0.46	6.61	0.53	0.13	-0.04	0.30	.123
22 MxDMP	6.67	0.54	6.57	0.53	0.10	-0.08	0.28	.272
23 MxDDP	7.65	0.39	7.40	0.38	0.25	0.12	0.38	.001 ***
23 MxDMP	7.83	0.44	7.56	0.48	0.27	0.12	0.43	.001 ***
24 MxDDP	8.33	0.61	8.12	0.55	0.21	0.01	0.41	.037 *
24 MxDMP	8.16	0.51	7.83	0.52	0.33	0.15	0.50	.001 ***
25 MxDDP	8.29	0.53	8.04	0.63	0.25	0.05	0.44	.014 **
25 MxDMP	8.29	0.52	7.94	0.59	0.36	0.17	0.54	.001 ***
26 MxDDP	11.01	0.58	10.73	0.61	0.28	0.08	0.48	.006 **
26MxDMP	12.44	0.63	12.17	0.57	0.28	0.07	0.48	.008 **
27 MxDDP	9.61	0.85	9.59	1.26	0.01	-0.34	0.37	.938
27 MxDMP	10.86	1.03	10.78	0.90	0.07	-0.26	0.40	.659

*FDI notation; SM, hirox digital stereomicroscope; MxDDP, maxillary diagonal distopalatal diameter; MxDMP, maxillary diagonal mesiopalatal diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (***)p<0.001, (**)p<0.01 and (*)p<0.05).

studies formerly carried out by means of odontometric measurements with the avowal of sexual disparities^{11,13,47-49}. Arch dimensions of the maxilla and mandible were also measured. The arch dimensions showed sexual disparities, with the male having the larger arch dimension than in female like other investigator⁵⁰.

Side differences were reported by various researchers for maxillary and mandibular arches^{31,51-52}. However others found no significant side differences in tooth size comparison^{19,28,53}. For the comparison of the right and left side maxillary and mandibular teeth size, we observed the asymmetries only in the mesiodistal width of the lateral incisors, canine and first premolar in maxilla and lateral incisor in mandible .

SM repossession is reckless and effectual because the digital models can be stored according to subject numeric data. An addition, it is possible to view digital models at numerous whereabouts linked to internet^{18,20,54}), SM allowing patients to be treated at multiple locations with calm admittance of clinician and researcher to their records. The digital data for dental model can be warehoused on an organization CPU's hard drive, on movable flash drive and CDs. These new digital models untangle many snags come across with conventional plaster study models Recent state-of-the-art innovations have enhanced the process of cast fabrication and manipulation⁵⁵.

In comparison to SM the DC has the shortcoming like, time

consumption, difficulty in placement of device by operator, very prone to error and also the damage to the dental models due to its sharp beaks were common. The same time the measurement via DC is manual, cause the corporeal mutilation and create dust or extra muddle.

Our study provides a database of tooth size and arch dimensions from both measurement techniques for first time on Pakistani population. These norms will be helpful for the clinical treatment planning in orthodontic, prosthodontics, and restorative dentistry. Contemporaneously the norms will be of great value in forensic dentistry, and dental anthropology.

In conclusion, there were no significant differences observed in the data acquisition via conventional DC and SM.

- Norms were developed based on DC and SM, the teeth size were quantified in-

- Mesiodistal crown diameter.

- Buccolingual crown diameter.

- Diagonal crown diameter.

- Norms were developed for the arch dimension of maxilla and mandible based on DC and SM techniques.

- There is no difference between the right and left side of the maxillary and mandibular teeth except for the few variables in mesiodistal crown diameters.

- Mesiodistal, buccolingual, diagonal teeth crown diameters and

Table 14. Mandibular arch diagonal crown dimension measurement via SM, Norms and Inter sex disparities.

Variables*	Male		Female		Mean diff. 95% CI		P	
	Mean	SD	Mean	SD	Lower	Upper		
31 MnDDL	5.31	0.35	5.28	0.52	0.03	-0.11	0.18	.668
31 MnDML	5.22	0.34	5.21	0.55	0.01	-0.14	0.16	.903
32 MnDDL	5.82	0.40	5.70	0.46	0.12	-0.02	0.26	.104
32 MnDML	5.75	0.41	5.68	0.48	0.08	-0.07	0.23	.310
33 MnDDL	6.66	0.36	6.44	0.47	0.21	0.08	0.35	.003 **
33 MnDML	6.89	0.40	6.62	0.47	0.27	0.12	0.41	.001 ***
34 MnDDL	6.93	0.40	6.82	0.46	0.11	-0.03	0.25	.130
34 MnDML	7.30	0.44	7.07	0.50	0.23	0.08	0.39	.004 **
35 MnDDL	7.61	0.46	7.50	0.58	0.11	-0.07	0.29	.220
35 MnDML	7.84	0.50	7.62	0.65	0.22	0.02	0.41	.028 *
36 MnDDL	11.39	0.57	11.10	0.59	0.29	0.09	0.48	.004 **
36 MnDML	11.86	0.57	11.58	0.57	0.28	0.09	0.47	.004 **
37 MnDDL	10.91	0.70	10.51	0.67	0.40	0.17	0.63	.001 ***
37 MnDML	10.99	0.66	10.70	0.67	0.28	0.06	0.51	.013 *
41 MnDDL	5.31	0.35	5.28	0.52	0.03	-0.12	0.18	.685
41 MnDML	5.22	0.34	5.21	0.55	0.01	-0.14	0.16	.920
42 MnDDL	5.82	0.40	5.70	0.46	0.12	-0.02	0.27	.101
42 MnDML	5.75	0.41	5.68	0.48	0.08	-0.07	0.23	.304
43 MnDDL	6.66	0.36	6.44	0.47	0.21	0.07	0.35	.003 **
43 MnDML	6.89	0.40	6.62	0.47	0.27	0.12	0.42	.001 ***
44 MnDDL	6.93	0.40	6.82	0.46	0.11	-0.03	0.26	.124
44 MnDML	7.30	0.44	7.07	0.50	0.24	0.08	0.39	.004 **
45 MnDDL	7.61	0.46	7.50	0.58	0.11	-0.06	0.29	.211
45 MnDML	7.84	0.51	7.62	0.65	0.22	0.03	0.42	.026
46 MnDDL	11.39	0.57	11.09	0.59	0.30	0.11	0.50	.003 **
46 MnDML	11.86	0.57	11.58	0.57	0.28	0.09	0.47	.004 **
47 MnDDL	10.91	0.70	10.49	0.67	0.42	0.19	0.65	.001 ***
47 MnDML	10.98	0.65	10.70	0.67	0.28	0.05	0.50	.015 *

*FDI notation; SM, hirox digital stereomicroscope; MnDDL, mandibular diagonal distolingual diameter; MnDML, mandibular diagonal mesiolingual diameter; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (***)p<0.001, (**)p<0.01 and (*)p<0.05).

Table 15. Maxillary and mandibular arch dimension measurement via SM, Norms and Inter sex disparities.

Variables	Male		Female		Mean diff. 95% CI		P	
	Mean	SD	Mean	SD	Lower	Upper		
UAP	97.51	4.55	94.87	4.40	2.64	1.13	4.15	.001 ***
UAL	130.56	4.75	127.39	5.65	3.17	1.42	4.92	.001 ***
UICW	35.99	1.94	34.26	2.35	1.73	1.00	2.45	.001 ***
UI1PW	43.37	2.06	42.00	3.06	1.37	0.51	2.24	.002 **
UI2PW	48.97	2.31	47.04	2.45	1.93	1.13	2.74	.001 ***
UIMW	53.97	2.58	52.15	2.34	1.82	0.98	2.65	.001 ***
LAP	90.71	4.97	87.86	3.73	2.85	1.35	4.35	.001 ***
LAL	111.53	4.21	109.84	4.93	1.69	0.15	3.23	.032 *
LICW	27.05	2.00	26.24	1.82	0.82	0.17	1.47	.014 *
LI1PW	35.88	1.94	34.49	2.53	1.40	0.64	2.15	.001 ***
LI2PW	41.78	2.47	40.43	2.57	1.35	0.50	2.20	.002 **
LIMW	46.70	2.44	45.16	2.36	1.55	0.73	2.36	.001 ***

SM, hirox digital stereomicroscope; UAP, upper arch perimeter; UAL, upper arch length; UICW, upper inter canine width; UI1PW, upper inter first premolar width; UI2PW, upper inter second premolar width; UIMW, upper inter molar width; LAP, lower arch perimeter; LAL, lower arch length; LICW, Lower inter canine width; LI1PW, Lower inter first premolar width; LI2PW, Lower inter second premolar width; LIMW, Lower inter molar width; CI, confidence interval; SD, standard deviation; Mean diff., mean differences; (***)p<0.001, (**)p<0.01 and (*)p<0.05).

arch dimension presented the sexual dimorphism with the greatest value for male were observed.

- The developed norms will be help-full adjunct in orthodontic treatment planning for; tooth size discrepancies, tooth size and arch length discrepancies.

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