

## ORIGINAL ARTICLE

## Gender Determination among Children using Cast Analysis of Deciduous Dentition

JAVARIA IMTIAZ<sup>1</sup>, IHSAN ULLAH<sup>2</sup>, BENISH ALEEM<sup>3</sup><sup>1</sup>Department of Oral Pathology, Bacha Khan College of Dentistry Mardan, Pakistan<sup>2</sup>Institute of Pathology and Diagnostic Medicine, Khyber Medical University, Peshawar, Pakistan<sup>3</sup>Department of Oral Pathology, Institute of Pathology and Diagnostic Medicine, Khyber Medical University, Peshawar, PakistanCorrespondence to: Dr Ihsan Ullah, Email: [drihsan.ibms@kmu.pk](mailto:drihsan.ibms@kmu.pk)

## ABSTRACT

**Background:** Forensic odontology is an important aspect of legal process and the concept in pediatric cases a new one. The identification of human body by using facial and dental in children is emerging and the need of the growing world. Therefore, the study was designed to determine gender children using cast analysis of deciduous dentition.

**Material and Methods:** A cross-sectional study was conducted at the Institute of Pathology & Diagnostic Medicine, Khyber Medical University Peshawar, Pakistan, for the duration from March 2023 to August 2023. A total of 268 children, equal number of boys and girls of age 3-6 years were included in the study through non-probability convenience sampling technique. Ethical approval was obtained from the institutional ethical committee and consent was obtained for the parents of children. Odontometric analysis included mesiodistal dimensions, buccolingual dimensions and clinical crown height of all primary teeth, maxillary and mandibular arch length, inter canine distance and inter molar distance of maxilla and mandible were measured using cast analysis and vernier caliper. The statistical significance difference of all variables between female and male was analyzed by independent t-test.

**Results:** The difference was existed in mean value of both genders in mesiodistal dimensions of maxillary central incisors (right -0.1478 & left -0.1201), maxillary right canine (0.1336), mandibular left central incisor (0.1761), mandibular lateral incisor (right 0.3037 & left 0.3015) and mandibular 1<sup>st</sup> molar (right 0.3276 & left 0.3045). Buccolingual dimensions of all teeth showed significant difference in female and male except maxillary central incisors (p-value 0.374). Clinical crown height of maxillary lateral incisor and all mandibular teeth except right 2<sup>nd</sup> molar were found significant having p-value less than 0.05. Maxillary arch inter canine distance and mandibular arch length were greater in male as compared to female, p-value was 0.014 & 0.030 while mean difference was -0.6478 & -1.1455 respectively.

**Conclusions:** In the deciduous dentition, teeth dimensions were bigger in boys than girls. Hence it was found that primary teeth could be used for estimation of gender among children in different emergencies and tragedies.

**Keywords:** Gender determination, deciduous dentition, odontometric analysis

## INTRODUCTION

Forensic odontology is that part of dentistry which involves in the recognition of unidentified human body by using dental knowledge<sup>1, 2</sup>. Forensic odontologist should gathered required information in the post-mortem, dental examination and dental autopsy should be considered separately<sup>3, 4</sup>. There is sudden increase in death ratio from an era because of road traffic accidents, natural disasters and unlawful actions. Recognition of the dead bodies and death causes is an important parameter for different investigations. Unavailability of verification leads to deadlock in the investigations. At crime scene when unrecognizable human body come across, utmost responsibility is to find the identification, for speed up the legal procedures and returned the body to the extended family<sup>5</sup>. Different specialties required forensic dentistry knowledge, as dental records are used to assess different unknown cases easily by the officials<sup>6</sup>.

For human recognition the skeletal and dental residues used in the forensic science as the teeth and jawbones are distinctive because they are guarded by rigid coating. These structures are distinguished by their remarkable resistance to decay and external object's reaction that damage the soft tissue of the body easily<sup>7</sup>. Forensic anthropologist deals with skeletal and dental undissolved particles, blood, hair specimen, footmark, finger impressions, etc., four main characteristics of biological specification (gender, genetic heritage, physical height and age) are used in the identification of persons whose death happened naturally or unclear<sup>8</sup>. The chemically stable and strong tissue of the body is teeth which can be conserved for forensic analysis and developmental changes. Teeth are resistant to fire and bacterial decomposition, which make it key in the recognition of gender, age and race on odontometric specifications. When the skeletal variables are inaccessible because of disappearance or disintegration in an accident/ mishap, the teeth become eminent<sup>9</sup>. Teeth and jawbones have remarkable

characteristics for forensic investigations.

Sexual dimorphism is the structural differentiation among males and females of the identical species as no two mouths are same<sup>7</sup>. Multiple studies confirmed that sexual dimorphism existent in particular community and also within the same community. During the procedure of forensic human recognition, initial step is the verification of gender which reduces the different possibilities into half. Although gender verification is performed before that age and physical height evaluation. Tooth development is complicated procedure control the tooth form, structure and size which is regulated by about 300 genes<sup>8</sup>. Most of the studies on permanent dentition show that female teeth are smaller than male teeth but reverse dimorphism also arise in some cases. Because of genetic variation, food quality and quantity difference, change circumstances sexual dimorphism may differ among different populations<sup>10</sup>. If the gender determination by tooth crown size of deciduous teeth is that much noticeable as in the permanent teeth, so gender of the children may be accurately evaluated. Gender determination studies based on the odontometric analysis of deciduous dentition were limited. The aim of the current study is to determine the gender of the children accurately by using mesiodistal and bucco-lingual dimensions, clinical crown height of deciduous teeth.

## MATERIAL AND METHODS

A cross sectional study was conducted at the Institute of Pathology & Diagnostic Medicine (IP&DM) of Khyber Medical University (KMU) Peshawar, Pakistan, for the duration from March 2023 to August 2023. Total 268 children (134 boys and 134 girls) age 3-6 years, were selected in the OPD of the Department of Paedodontics and Preventive Dentistry at Bacha Khan College of dentistry, Mardan, Khyber Pakhtunkhwa, Pakistan through non-probability convenience sampling technique. All children with primary dentition having sound teeth (aged 3-6 years) and both genders were included, however, uncooperative children were excluded. Every child was seated upright in a comfortable position

Received on 06-11-2023

Accepted on 29-12-2023

with head resting firmly. Impression was taken with agar in disposable perforated impression tray. Impression tray was removed with sudden pull followed by casting. For recognition each maxillary and mandibular study cast was numbered. Digital vernier calipers was used for measurements of clinical crown height, inter canine width, inter molar width, Mesio-distal and bucco-lingual dimensions. Mesio-distal dimension was measured between mesial surface and distal surface of each tooth.

Bucco-lingual dimensions was measured between buccal/labial surface and lingual/palatal surface of each tooth. Clinical crown height was measured from incisal edge to cervical line of incisors, Cuspal tip to cervical line of canine and mesiolingual cusp to the cervical line in molars. Inter canine width was measured from cusp tip of right canine to the cusp tip of left canine in both arches. Inter molar width was measured in maxillary arch from central fossa of right maxillary first molar to the central fossa of left maxillary first molar while in mandibular arch measured from distobuccal cusp tip of right first mandibular molar to the distobuccal cusp tip of left first mandibular molar.

Maxillary and mandibular arch length was measured by 0.033 inches brass wire. One end of the wire was at distal surface of right molar to the distal surface of left molar, on buccal aspect of the arch. Digital vernier caliper was used for measurement of mesiodistal dimension of maxillary canine and buccolingual dimension of mandibular 2<sup>nd</sup> molar. Brass wire was used for recording of the mandibular arch length, which represent the measuring technique of both maxillary and mandibular arch length of whole data. Furthermore, digital vernier caliper was used for

recording inter molar distance of maxillary arch, which represent the whole data of both male and female. The inter canine distance of maxillary arch and clinical crown height of the mandibular canine was recorded with digital vernier caliper. A representative figure of the whole data is presented. The data was analyzed by Statistical Package for Social Sciences (SPSS) version 22. The quantitative variables, Mesio-distal dimension, Bucco-lingual dimension, clinical crown height, inter canine distance, inter molar distance, arch length was described as mean value of both genders. The statistical significance difference of all variables between female and male was analyzed by independent t-test (parametric test). The negative t-test value showing male dimensions are greater, while the positive t-test value showing female dimensions are greater. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

The mesiodistal dimensions of central incisors and right canine in maxilla is significantly different in both genders. The p-value is less than 0.05 of mesiodistal dimensions of left central incisor, lateral incisors and 1<sup>st</sup> molar in mandible (table 1). There is significant difference in female and male buccolingual dimensions of all teeth except maxillary central incisors (table 2). The clinical crown height is not different in maxillary arch except lateral incisors among both genders. There is significantly statistical difference in mandibular teeth clinical crown height except right 2<sup>nd</sup> molar (table 3). Inter canine distance of maxilla and arch length in mandible is greater in male (table 4).

Table 1: Mesiodistal dimensions of maxilla and mandible

| Tooth number                           | Female | Male  | t- Test value | P value | Tooth number                          | Female | Male  | t- Test value | P value |
|----------------------------------------|--------|-------|---------------|---------|---------------------------------------|--------|-------|---------------|---------|
| Maxillary Right central incisor        | 6.222  | 6.369 | -2.755        | .006    | Maxillary Left central incisor        | 6.249  | 6.369 | -2.009        | .046    |
| Maxillary Right lateral incisor        | 5.192  | 5.228 | -.659         | .511    | Maxillary Left lateral incisor        | 5.201  | 5.132 | 1.276         | .203    |
| Maxillary Right canine                 | 6.513  | 6.380 | 2.717         | .007    | Maxillary Left canine                 | 6.459  | 6.405 | .876          | .382    |
| Maxillary Right 1 <sup>st</sup> molar  | 6.995  | 6.925 | 1.268         | .206    | Maxillary Left 1 <sup>st</sup> molar  | 6.923  | 6.914 | .167          | .868    |
| Maxillary Right 2 <sup>nd</sup> molar  | 8.608  | 8.616 | -.113         | .910    | Maxillary Left 2 <sup>nd</sup> molar  | 8.516  | 8.485 | .432          | .666    |
| Mandibular Right central incisor       | 4.269  | 4.161 | 1.462         | .145    | Mandibular Left central incisor       | 4.354  | 4.178 | 2.317         | .021    |
| Mandibular Right lateral incisor       | 4.663  | 4.359 | 5.647         | .000    | Mandibular Left lateral incisor       | 4.686  | 4.384 | 5.112         | .000    |
| Mandibular Right canine                | 5.520  | 5.410 | 1.908         | .057    | Mandibular Left canine                | 5.476  | 5.377 | 1.867         | .063    |
| Mandibular Right 1 <sup>st</sup> molar | 7.571  | 7.243 | 3.103         | .002    | Mandibular Left 1 <sup>st</sup> molar | 7.588  | 7.284 | 3.087         | .002    |
| Mandibular Right 2 <sup>nd</sup> molar | 9.340  | 9.796 | -.977         | .329    | Mandibular Left 2 <sup>nd</sup> molar | 9.292  | 9.335 | -.537         | .592    |

Table 2: Buccolingual dimensions of maxilla and mandible

| Tooth number                           | Female | Male  | t- Test value | P value | Tooth number                          | Female | Male  | t- Test value | P value |
|----------------------------------------|--------|-------|---------------|---------|---------------------------------------|--------|-------|---------------|---------|
| Maxillary Right central incisor        | 4.016  | 3.957 | .891          | .374    | Maxillary Left central incisor        | 3.999  | 3.944 | .836          | .404    |
| Maxillary Right lateral incisor        | 3.753  | 3.560 | 3.551         | .000    | Maxillary Left lateral incisor        | 3.737  | 3.513 | 4.178         | .000    |
| Maxillary Right canine                 | 4.936  | 4.787 | 2.642         | .009    | Maxillary Left canine                 | 4.815  | 4.619 | 3.459         | .001    |
| Maxillary Right 1 <sup>st</sup> molar  | 7.372  | 7.534 | -2.220        | .027    | Maxillary Left 1 <sup>st</sup> molar  | 7.281  | 7.503 | -3.156        | .002    |
| Maxillary Right 2 <sup>nd</sup> molar  | 8.487  | 9.001 | -6.257        | .000    | Maxillary Left 2 <sup>nd</sup> molar  | 8.469  | 8.789 | -3.690        | .000    |
| Mandibular Right central incisor       | 2.756  | 2.946 | -2.835        | .005    | Mandibular Left central incisor       | 2.734  | 2.865 | -2.127        | .034    |
| Mandibular Right lateral incisor       | 2.881  | 3.001 | -2.059        | .040    | Mandibular Left lateral incisor       | 2.870  | 3.046 | -2.954        | .003    |
| Mandibular Right canine                | 3.579  | 3.794 | -2.974        | .003    | Mandibular Left canine                | 3.569  | 3.801 | -3.810        | .000    |
| Mandibular Right 1 <sup>st</sup> molar | 5.938  | 6.160 | -2.218        | .027    | Mandibular Left 1 <sup>st</sup> molar | 5.990  | 6.196 | -2.358        | .019    |
| Mandibular Right 2 <sup>nd</sup> molar | 7.727  | 8.150 | -4.727        | .000    | Mandibular Left 2 <sup>nd</sup> molar | 7.735  | 8.102 | -4.017        | .000    |

Table 3: Clinical crown height dimensions of maxilla and mandible

| Tooth number                           | Female | Male  | t- Test value | P value | Tooth number                          | Female | Male  | t- Test value | P value |
|----------------------------------------|--------|-------|---------------|---------|---------------------------------------|--------|-------|---------------|---------|
| Maxillary Right central incisor        | 5.548  | 5.223 | .824          | .411    | Maxillary Left central incisor        | 5.140  | 5.224 | -1.153        | .250    |
| Maxillary Right lateral incisor        | 4.549  | 4.720 | -2.581        | .010    | Maxillary Left lateral incisor        | 4.509  | 4.681 | -2.975        | .003    |
| Maxillary Right canine                 | 5.666  | 5.668 | -.024         | .981    | Maxillary Left canine                 | 5.608  | 5.661 | -.847         | .398    |
| Maxillary Right 1 <sup>st</sup> molar  | 4.796  | 4.815 | -.317         | .752    | Maxillary Left 1 <sup>st</sup> molar  | 4.704  | 4.710 | -.081         | .936    |
| Maxillary Right 2 <sup>nd</sup> molar  | 4.580  | 4.634 | -.953         | .341    | Maxillary Left 2 <sup>nd</sup> molar  | 4.673  | 4.679 | -.074         | .941    |
| Mandibular Right central incisor       | 4.543  | 4.813 | -4.310        | .000    | Mandibular Left central incisor       | 4.475  | 4.799 | -5.015        | .000    |
| Mandibular Right lateral incisor       | 4.649  | 4.910 | -4.680        | .000    | Mandibular Left lateral incisor       | 4.604  | 4.910 | -5.308        | .000    |
| Mandibular Right canine                | 5.389  | 5.579 | -3.042        | .003    | Mandibular Left canine                | 5.317  | 5.551 | -3.602        | .000    |
| Mandibular Right 1 <sup>st</sup> molar | 4.820  | 5.084 | -3.601        | .000    | Mandibular Left 1 <sup>st</sup> molar | 4.813  | 5.073 | -3.432        | .001    |
| Mandibular Right 2 <sup>nd</sup> molar | 4.498  | 4.616 | -1.796        | .074    | Mandibular Left 2 <sup>nd</sup> molar | 4.434  | 4.596 | -2.537        | .012    |

Table 4: Arch length, inter canine distance & inter molar distance of maxilla and mandible

| Arch perimeters                 | Female | Male   | t-test value | P value | Arch perimeters                  | Female | Male   | t-test value | P value |
|---------------------------------|--------|--------|--------------|---------|----------------------------------|--------|--------|--------------|---------|
| Maxillary Arch Length           | 77.653 | 78.022 | -.583        | .561    | Mandibular Arch Length           | 71.772 | 72.918 | -2.176       | .030    |
| Maxillary Inter Canine Distance | 28.257 | 28.905 | -2.477       | .014    | Mandibular Inter Canine Distance | 24.404 | 24.014 | 1.665        | .097    |
| Maxillary Inter Molar Distance  | 37.328 | 37.470 | -.414        | .679    | Mandibular Inter Molar Distance  | 33.935 | 34.019 | -.342        | .733    |

## DISCUSSION

Human beings are ethnographically distributed into different categories on basis of dental morphology by researchers as the people community belongs to different geographical location<sup>11</sup>. Metric method of odontometric analysis for gender determination is providing more accurate and persistent results<sup>12</sup>. Mesiodistal and buccolingual dimensions are most frequently using method while clinical crown height measurements are rarely used in gender assessment. In the children tooth is most reliable structure as rest of the body features are not properly developed<sup>9</sup>.

In the present study maxillary right and left central incisors only mesiodistal dimension is significantly wider in male. Right and left central incisors of mandible showing buccolingual and clinical crown height are more in male than female. Maxillary right and left lateral incisors buccolingual dimensions are more in female and clinical crowns are higher in male. The mandibular right and left lateral incisors showing significantly difference in all crown dimensions, mesiodistal dimensions are wider in female, buccolingual dimensions and clinical crown height have the same trend, greater in male. A study was conducted by Black TK reported that girls had wider mesiodistal dimension than boys in both arches incisors. Akshara Singh et al. showed that buccolingual dimension of central incisor of maxilla and mandible and lateral incisor of mandible were larger in female than male<sup>5</sup>.

The research conducted currently observe that maxillary right and left canine buccolingual dimensions are dominant in female, while in mandibular right and left canine, buccolingual and clinical crown height are more in male. Ingaleshwar, et al. study finding were that mandibular clinical crown height were similar in both genders while rest of the mandibular and maxillary canine dimensions were significantly different. Margetts and Brown observed that male had larger mesiodistal and buccolingual dimensions than female. A study conducted by Black proved the differences in primary teeth dimensions<sup>13</sup>.

The buccolingual dimensions are significantly greater in male for maxillary and mandibular, right and left molars in the current study, was supported by the study of Eswara K et al, that buccolingual dimensions were larger in boys primary molars<sup>14</sup>. Mesiodistal dimensions are wider in female right and left mandibular first molar. Clinical crowns of right and left mandibular first molar are higher in male. In mandible right and left first molars showing significant difference in all dimensions between both genders. Ahmed Ibrahim El Dosoky, et al showed that mandibular 2nd molar significantly greater dimensions in male<sup>1</sup>.

Shankar. S et al showed that inter canine distance mean value was significantly more in male<sup>15</sup>, which support the result of the current study. Maxillary arch analysis showing that only inter canine distance is significantly greater in male. The maxillary arch length and inter molar distance are same in girls and boys. Mandibular arch length is larger in male as compare to female. Inter canine distance and inter molar distance in mandible are significantly not different in both genders. Suazo, G. I. C.; Zavardino, M. D. A. & Smith, R. L and Fernandes, et al, found that inter molar distance in maxilla and mandible greater in males<sup>8, 16</sup>.

## CONCLUSION

In the deciduous dentition teeth dimensions are bigger in boys than girls in all dimensions except mesiodistal dimensions. Mandibular left central incisor, mandibular lateral incisors and mandibular first molar showing statistically significant difference in all crown dimensions. Hence it is concluded that primary teeth can be used for estimation of gender among children in different emergencies and tragedies.

## REFERENCES

1. Eldosoky A, Elgazzar F, Gonna S. Accuracy of Deciduous and Permanent Molar Teeth in Gender determination of Egyptian Children: Dental and Forensic Implications. *Egyptian Dental Journal*. 2020; 66(4-October (Orthodontics, Pediatric & Preventive Dentistry)):1955-62.
2. Pillai JP, Chokkalingam TS, Aasaithambi B, Nuzzolese E. Establishment of the forensic odontology department: A proposed model for the basic infrastructure and forensic odontology kit. *Journal of forensic dental sciences*. 2019; 11(2):64.
3. Savić Pavićin I, Jonjić A, Maretić I, Dumančić J, Zymberčesko A. Maintenance of dental records and forensic odontology awareness: A survey of Croatian dentists with implications for dental education. *Dentistry Journal*. 2021; 9(4):37.
4. Syed FMS, Shoro S, Mânica S. Pakistan's position in the world of forensic odontology and dental records. *The Journal of Forensic Odonto-stomatology*. 2020; 38(2):47.
5. Singh A, Bhatia HP, Sood S, Sharma N. Demystifying the mysteries: Sexual dimorphism in primary teeth. *J Clin Diagnostic Res*. 2017;11(4):ZC110-4.
6. Divakar KP. Forensic Odontology: The New Dimension in Dental Analysis. *Int J Biomed Sci [Internet]*. 2017;13(1):1-5.
7. Narayan Biswal B, Narayan Das S, Kumar Das B, Rath R. Alteration of cellular metabolism in cancer cells and its therapeutic. *J oral MaxillofacPathol*. 2017;21(3):244-51.
8. Fernandes LCC, Veloso CVL, Oliveira J de A, Genu PR, Santiago BM, Rabello PM. Odontometric analysis of molars for sex determination. *Brazilian J Oral Sci*. 2016;15(1):35-8.
9. Babu SS, Nair SS, Gopakumar D, Kurian N, Parameswar A, Baby TK. Linear odontometric analysis of permanent dentition as a forensic aid: A retrospective study. *J Clin Diagnostic Res*. 2016;10(5):ZC24-8.
10. Neves JA, Antunes-Ferreira N, Machado V, Botelho J, Proença L, Quintas A, et al. Sex prediction based on mesiodistalwidth data in the Portuguese population. *Appl Sci*. 2020;10(12):1-7.
11. Díaz E, García L, Hernández M, Palacio L, Ruiz D, Velandia N, et al. Frequency and variability of dental morphology in deciduous and permanent dentition of a Nasa indigenous group in the municipality of Morales, Cauca, Colombia. *Colombia Médica*. 2014; 45(1):15-24.
12. Bidmos MA, Gibbon VE, Strkalj G. Recent advances in sex identification of human skeletal remains in South Africa. *South African Journal of Science*. 2010; 106(11):1-6.
13. Nagare SP, Chaudhari RS, Birangane RS, Parkarwar PC. Sex determination in forensic identification, a review. *Journal of forensic dental sciences*. 2018; 10(2):61.
14. Eswara K, Avula JSS, Mallela GMK, Enuganti S, Margana JSPG, Kakarla P. Deciduous molar sizes and sexual dimorphism: South Indian study. *Journal of Pediatric Dentistry/Jan-Apr*. 2014; 2(1).
15. Shankar S, Nirmal RM, Aswathnarayanan M, Kruthika M, Fathima MA. Sex determination using maxillary arch width of pediatric population of Namakkal district, India: A forensic study. *Journal of Oral and Maxillofacial Pathology: JOMFP*. 2019; 23(3):480.
16. Galdames ICS, Matamala DAZ, Smith RL, SUAZO G, ZAVANDO M, SMITH R. Blind test of mandibular morphology with sex indicator in sub adult mandibles. *Int J Morphol*. 2008; 26(4):845-8.

**This article may be cited as:** Imtiaz J., Ullah I., Aleem B., Gender Determination among Children using Cast Analysis of Deciduous Dentition. *Pak J Med Health Sci*, 2023; 18(1): 1062-1064.