

# Assessment of fluctuating asymmetry in permanent dentition

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## Abstract

**Introduction:** Fluctuating asymmetry is the difference between the two sides of bilateral traits. The aim of this study was to assess fluctuating asymmetry of maxillary and mandibular arches in faciolingual and mesiodistal crown dimensions.

**Material and Methods:** This cross sectional study conducted from July to August' 2010, at the Aga Khan University Hospital, Karachi. Data was obtained from pre-treatment dental casts of 74 patients who visited the orthodontic clinic from June 2004 to August 2010. Antimeric pairs of the maxillary and mandibular permanent central incisors, canines and first molars were measured in mesiodistal and faciolingual crown dimensions. All measurements were done using digital vernier caliper. Paired sample t-test was used to depict the difference between the two sides of both jaws. Bland Altman test was used to assess the intra-examiner reliability for the measurements done in this study.

**Results:** Statistically significant differences were observed between right and left sides in the mesiodistal width of maxillary canines and buccolingual width of maxillary first molars.

**Conclusions:** Fluctuating asymmetry was observed between right and left sides in the mesiodistal width of maxillary canines and faciolingual width of maxillary first molars. Assessment of asymmetry should be done for every patient before initiation of orthodontic treatment for its input in treatment planning.

**Keywords:** Antisymmetry; mesiodistal and faciolingual dimension; secondary dentition

## Introduction

Symmetry is defined as the similar arrangement in form and relationship of parts around a common axis or on each side of a plane of the body.<sup>1</sup> In clinical context, symmetry merely means balance and asymmetry means imbalance.<sup>2</sup> Types of asymmetries are: directional, antisymmetry and fluctuating asymmetry.<sup>3</sup>

The directional asymmetry is defined as a tendency for one side of a trait to develop more than the other but the larger side is usually the same side for all individuals and is under genetic control. Well-known example of directional asymmetry is the human lungs where three lobes are found on right side whereas two lobes are present on left side of

the body. Harris depicted directional asymmetry on pre-treatment model of patients undergoing orthodontic treatment.<sup>4</sup> He found that the left side of the dental arch was on average longer than the right side with substantial individual variation. Thus he concluded that it is perhaps because of hemispheric size differences in central nervous system. In contrast antisymmetry is defined as one side being larger than the other with no way of prediction, which side would be of greater dimension.<sup>5</sup> It is also under genetic control but less common as in comparison with directional asymmetry. Both directional and antisymmetry are considered as developmentally normal and help in achievement of adaptive or functional demands of the human body.

Fluctuating asymmetry is defined as a difference between the two sides of bilateral traits.<sup>5</sup> More precisely, it is defined as a failure of the organism to grow identical in form of bilaterally homologous structures.<sup>6</sup> It is also

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referred to as small random variations from perfect symmetry in bilaterally paired structures. It is found in both primary as well as in the permanent dentition.<sup>7</sup> Based on oral biology of developing dentition, it is expected that primary teeth are more developmentally stable and exhibit less asymmetry in comparison to its permanent successors. Presence of fluctuating asymmetry is a sign of failure of an organism to cope with genetic and environmental stress during its development. Hence, in various studies,<sup>8, 9, 10</sup> it has been used as an indicator of developmental instability. The results of these studies indicated that the highest level of fluctuating asymmetry is associated with dietary and parasitic stress and decreased buffering capacity of an individual.

Assessment of fluctuating asymmetry in human dentition can be done by measuring faciolingual, mesiodistal and occlusovertical crown dimensions, intercuspal distances and calculation of tooth surface area on study cast or by using image analysis system. This helps us in finding developmental instability,<sup>11</sup> environmental stress in a population,<sup>12</sup> prediction of dental crowding and selection of proper treatment. The aim of this study was to assess fluctuating asymmetry of maxillary and mandibular arches in faciolingual and mesiodistal crown dimensions.

## Material and Methods

Cross sectional study was conducted from July to August' 2010, at the Aga Khan University Hospital, Karachi. Data were obtained from pre-treatment dental casts of 74 patients (21 males, 53 females) with an age range of 9.6 to 44 years. Informed consent was taken from patients for study who visited the orthodontic clinic from June 2004 to August 2010. Antimeric pairs of the maxillary and mandibular permanent central incisors, canines and first molars were measured in mesiodistal and faciolingual crown dimensions. Data collection was done by using non-probability purposive sampling

technique. Inclusion criteria for sample selection were subjects of Pakistani origin, having permanent dentition and fully erupted central incisors, canines and first molars. The exclusion criteria were presence of craniofacial anomalies, congenitally missing teeth and previous orthodontic, restorative, or prosthetic procedures. Patients having cleft lip and palate were not included as this has been associated with a decrease in tooth size on the affected side of the dental arch.

Criteria for selection of the study casts included the requirement of the presence of well defined margins of all teeth to be measured. This allowed adequate access for the beaks of the digital vernier caliper. Carious, worn or fractured teeth were also excluded. All measurements were done by the principal investigator on study casts using sliding digital vernier caliper (0-150 mm ME 00183, Dentaurm, Pforzheim, Germany) with an accuracy of  $\pm 0.02$  mm and repeatability of  $\pm 0.01$  mm (manufacturer specification). Mesiodistal dimension of selected pairs of teeth was measured between contact points of a tooth in normocclusion. Faciolingual dimension was measured as maximum breadth of the tooth perpendicular to the mesiodistal dimension at the gingival margin. Measurements were taken perpendicular to the long axis of the tooth, with digital caliper entering the interproximal area from either the facial or the occlusal side.

Data analysis was done by using SPSS for windows Version 16.0 (SPSS Inc. Chicago, IL). Descriptive statistics including means and standard deviations were calculated for age. Paired sample t-test was used to compare right and left sides of teeth in both the jaws. *P* value equal to or less than 0.05 was taken as statistically significant.

In order to establish the reproducibility, ten casts were randomly selected by lottery method, which were re-assessed after two months by the principal investigator. Bland Altman technique<sup>13</sup> was used to assess the

intra-examiner reliability for the measurements done in this study.

## Results

The sample consisted of 74 dental casts (21 males with average age of  $18.40 \pm 6.24$  and 53 females with average age of  $18.84 \pm 7.29$  years). Mean age and gender distribution of the patients included in the study are shown in Table I.

**Table I: Mean age and gender distribution**

Gender	Mean age Years $\pm$ SD	Minimum age Years	Maximum age Years
Males (n=21)	$18.40 \pm 6.24$	11	36
Females (n=53)	$18.84 \pm 7.29$	9.67	44

n=74

**Table II: Fluctuating asymmetry for mesiodistal widths**

Teeth	Right Mean $\pm$ SD mm	Left Mean $\pm$ SD mm	p-value
Maxillary central incisor	$8.54 \pm 0.80$	$8.55 \pm 0.78$	0.39
Maxillary canine	$8.15 \pm 0.69$	$8.07 \pm 0.73$	0.05*
Maxillary first molar	$10.33 \pm 0.87$	$10.34 \pm 0.93$	0.88
Mandibular central incisor	$5.53 \pm 0.54$	$5.55 \pm 0.50$	0.68
Mandibular canine	$7.06 \pm 0.75$	$7.13 \pm 0.78$	0.11
Mandibular first molar	$11.10 \pm 0.99$	$11.14 \pm 1.00$	0.44

n=74, Paired t-test, \* $p \leq 0.05$

Results for paired sample t-test are shown in Table II and III. Statistically significant difference was seen in mesiodistal width of maxillary canine and faciolingual width of maxillary first molar between right and left sides in the study sample.

Bland Altman test was used to assess the intra-examiner reliability. Good intra-

examiner reliability existed for the two measurements as shown in Figure 1, with a mean difference of 0.03 (95% confidence interval for the difference -0.09 to 0.026).

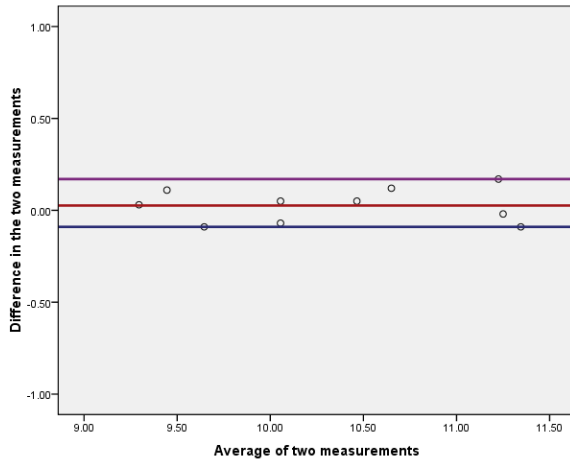
**Table III: Fluctuating asymmetry for faciolingual widths**

Teeth	Right Mean $\pm$ SD	Left Mean $\pm$ SD	p-Value
Maxillary central incisor	$6.89 \pm 0.76$	$6.90 \pm 0.72$	0.76
Maxillary canine	$7.66 \pm 0.67$	$7.62 \pm 0.74$	0.43
Maxillary first molar	$10.89 \pm 0.64$	$11.00 \pm 0.64$	0.005**
Mandibular central incisor	$5.61 \pm 0.69$	$5.60 \pm 0.64$	0.71
Mandibular canine	$6.78 \pm 0.64$	$6.87 \pm 0.70$	0.11
Mandibular first molar	$10.49 \pm 0.60$	$10.42 \pm 0.74$	0.26

n=74, Paired t-test, \*\* $p \leq 0.01$

## Discussion

Investigation of the asymmetry between bilateral structures is used as an important measure to assess the amount of developmental instability that occurred during growth and development of an individual. Moreover, it has a clinical importance in the diagnosis and treatment planning of orthodontic patients. Correct initial assessment of tooth size discrepancy helps the orthodontist in selection of best treatment option and management of a specific problem.



**Figure 1: Scatter plot for assessing intra-examiner reliability**

The present study was conducted to assess the magnitude and expression of the dental asymmetry in our study sample. Three pairs of teeth were selected because of their relative importance in the dental arch. Each pair of teeth is the first one in separate developmental fields and thus less likely to exhibit asymmetry.<sup>14</sup> Central incisors determine the midline and are important for esthetic reasons whereas canines are considered as cornerstones of the dental arch and first molars are taken as key to occlusion. A study conducted by Kieser and Groeneveld<sup>12</sup> on 106 South African black's found high fluctuating asymmetry for central incisors, canines and premolars in both mesiodistal and buccolingual crown dimensions. Their study result indicates that the highest level of asymmetry in South African population could be the effect of greater disease and malnutrition burden. The results of our study are in agreement for the mesiodistal widths of maxillary canine. However, in this study statistically significant difference was also found in the faciolingual widths of maxillary first molars.

Another study conducted by Kieser et al<sup>8</sup> on 202 Leguna Indians in Paraguay reported antimeric differences of tooth sizes and depicted that the first molars and canines were least asymmetric, while the lateral

incisors exhibited the greatest amount of asymmetry. The results of the present study were contradictory to their study, in which greatest asymmetry was found in maxillary canines and first molars.

Sprowl<sup>15</sup> conducted a study in Indiana University School of Dentistry on pre-treatment casts of 28 orthodontic patients, predominantly of Northern European descent. All subjects showed some degree of crowding, rotations, broken contacts and midline discrepancies. He calculated composite measure of total weighted dental fluctuating asymmetry in antimeric teeth and found highly significant asymmetry for all measured variables i.e. maxillary and mandibular central incisors, canines and first molars ( $p$ -value  $\leq 0.000$ ). The present study established that significant difference was seen for only maxillary canines and molars. Although the result is statistically significant but the magnitude of asymmetry appeared in the study is clinically insignificant.

The present study was a clinic-based study done in one of the largest tertiary care hospitals of Pakistan; therefore, the results of the current study cannot be generalized to Pakistani population. Purposive sampling technique was used and data were collected from a pool of orthodontic patients meeting the inclusion criteria who might have tooth size discrepancies, crowding, spacing and malalignment. Therefore, a greater chance of fluctuating asymmetry was present in these groups of patients. Garn et al<sup>16</sup> stated that the high magnitude of fluctuating asymmetry is possibly because of limited sample size. In the current study, adequate sample size was included in order to achieve greater reliability and absence of the systemic errors in the results.

Since asymmetry is a major contributor to malocclusion it is suggested that population based randomized control trials should be done with consideration of larger sample size to assess gender dimorphism and fluctuating asymmetry in mixed and primary dentition.

## Conclusions

Fluctuating asymmetry existed between right and left sides in the mesiodistal widths of maxillary canines and faciolingual widths of maxillary first molars. Despite being statistically insignificant it has clinical implications hence it is recommended that assessment of asymmetry should be done for every patient before initiation of orthodontic treatment for its input in treatment planning.

## References

1. Garn SM, Lewis AB, Kerewsky RS. The meaning of bilateral asymmetry in the permanent dentition. *Angle Orthod* 1966;36:55-62.
2. Fischer B. Asymmetries of the dentofacial complex. *Angle Orthod* 1954;24:179-92.
3. Van Valen L. A study of fluctuating asymmetry. *Evolution* 1962;16:125-42.
4. Harris EF, Bodford K. Bilateral asymmetry in the tooth relationships of orthodontic patients. *Angle Orthod* 1998;77:779-86.
5. Corruccini RS, Potter RH. Developmental correlates of crown component asymmetry and occlusal discrepancy. *Am J Phys Anthropol* 1981;55:21-31.
6. Cassidy KM, Harris EF, Tolley EA. Genetic influence on dental form in orthodontic patients *Angle Orthod* 1998;68:445-54.
7. Black TK. Fluctuating asymmetry in the deciduous dentition. *J Dent Res* 1980;59:1168-69.
8. Kieser JA, Groeneveld HT, Preston CB. Fluctuating odontometric asymmetry in the lengua Indians of Paraguay. *Ann Hum Biol* 1986;13:489-98.
9. Møller AP, Sanotra GS, Vestergaard KS. Developmental stability in relation to population density and breed of chicken gallus gallus. *Poul Sci* 1995;74:1761-71.
10. Di Bannardo R, Balilit H.L. Stress and dental asymmetry in a population of Japanese children. *Am J Phys Anthropol* 1978;48:89-94.
11. Perzigian AJ. Fluctuating dental asymmetry variation among skeletal populations. *Am J Phys Anthropol* 1977;47:81-88.
12. Kieser J.A, H.T Groeneveld. Fluctuating odontometric asymmetry in urban South African black population. *J Dent Res* 1988;67:1200-05.
13. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986;Feb 8;1(8476):307-10.
14. Saunders SR, Mayhall JT. Fluctuating asymmetry of dental morphological traits: new interpretations. *Hum Biol* 1982;54:789-99.
15. Sprowl's MW, Ward RE, Jamison PL, Hartfield JK. Dental arch asymmetry, fluctuating dental asymmetry and dental crowding. *Semin Ortho* 2008;14(2):157-65.
16. Garn SM, Smith BH, Moyers RE. Structured dimensional and developmental dental asymmetry. *Proc Finn Dent* 1981;77:33-36.