

Fluctuating asymmetry in various malocclusions: A thought provoking diagnostic parameter

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Abstract

Introduction: The assessment of fluctuating asymmetry has clinical importance in the diagnosis and treatment planning of orthodontic patients. The aim of the study was to assess fluctuating asymmetry in Angle Class I and Class II malocclusions and to assess its pattern in males and females respectively.

Material and Methods: It was a cross sectional study conducted in dental clinic at AKUH during the period of July 2010 to July 2011 on 100 subjects using non-probability purposive sampling technique. Digital vernier caliper was used to measure mesiodistal and buccolingual dimensions of the central incisors, canines and the first molars in maxillary and mandibular arches of subjects with Class I and Class II malocclusions.

Results: Fluctuating asymmetry was observed in both Class I and Class II malocclusions. The gender dimorphism was observed only in Class II malocclusion group.

Conclusions: Fluctuating asymmetry was found in both Class I and Class II malocclusion. However, gender dimorphism was seen in only Class II malocclusion. Hence, assessment of fluctuating asymmetry in various malocclusion groups should be considered as a vital diagnostic parameter in orthodontic case management.

Keywords: Fluctuating asymmetry; Class I and Class II malocclusion; Mesiodistal and buccolingual tooth dimensions

Introduction

Facial asymmetry was perhaps first observed by the artists of the Greek statuary who duplicated nature's normal facial asymmetries in their sculptures. Hass¹ was considered as pioneer in documenting asymmetry in the craniofacial region after studying these Greek sculptures. Some grade of asymmetry does exist in nature and is considered as developmentally normal.² Thus, recording these facial asymmetries serves to characterize and individualize esthetically pleasing faces rather than to disfiguring them.³ Most of the facial asymmetries are elusive, requiring bilateral comparisons for their detection and only noticeable on comparing and measuring paired structures. Like facial asymmetries, there are many forms of dental asymmetries. These asymmetries occur either due to congenital absence of teeth or imbalance in

tooth size on either sides of dental arches. It could be because of imbalance between tooth substances, arch size or as a consequence of imbalance between maxillary and mandibular dental arches.

Van Valen classified dental asymmetry in three types: directional, anti-symmetry and fluctuating asymmetry.⁴ Fluctuating asymmetry is defined as a difference between the two sides of bilateral traits.⁴ 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.

The purpose of present study was to compare fluctuating asymmetry in routine orthodontic patients having Angle's Class I and Class II malocclusion and to assess pattern of asymmetry in male and female subjects in both malocclusions. This can help us in finding out the tendency of developmental instability⁵ and selection of proper treatment in various malocclusions.

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Material and Methods

Cross sectional study was conducted from July 2010 to July 2011 at the Aga Khan University and Hospital, Karachi. All subjects were divided in two groups, Class I and Class II, based on Angles classification of malocclusion. Data were obtained from pre-treatment dental casts of 100 patients, Class I, 49 subjects (17 males, 32 females) and Class II, 51 subjects (14 males, 37 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 July 2011. Antimeric pairs of the maxillary and mandibular permanent central incisors, canines and first molars were measured in mesiodistal and faciolingual crown dimensions in subjects with Class I and Class II malocclusion. Data collection was done by using non-probability purposive sampling technique with inclusion criteria being; subjects of Pakistani origin, having permanent dentition, 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 the presence of a unilateral cleft lip and palate 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 would allow us 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 ± 0.02 mm and repeatability of ± 0.01 mm (manufacturer specification). Mesiodistal dimension of selected pairs of teeth was measured between contact points of a tooth in normocclusion whereas; 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). Paired sample t-test was used to assess fluctuating asymmetry in both the jaws in Class I and Class II malocclusion. Independent t-test was done to assess gender dimorphism. *P* value equal to or less than 0.05 was taken as statistically significant.

In order to establish the degree of reproducibility, 10 casts were randomly selected by lottery method, which were re-assessed after two months by the principal investigator. Bland Altman technique⁶ was used to assess the intra-examiner reliability for the measurements done in this study.

Results

The sample consisted of 100 dental casts (31 males with average age of 18.40 ± 6.24 and 69 females with average age of 18.84 ± 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=31)	18.40 \pm 6.24	11	36
Females (n=69)	18.84 \pm 7.29	9.67	44

Table II: Fluctuating asymmetry in Class I malocclusion

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	6.931	0.739	0.949
Maxillary Incisor Buccolingual Lt	6.928	0.710	
Maxillary Canine Buccolingual Rt	7.747	0.704	0.340
Maxillary Canine Buccolingual Lt	7.691	0.733	
Maxillary First Molar Buccolingual Rt	11.022	0.619	0.005 **
Maxillary First Molar Buccolingual Lt	11.160	0.649	
Maxillary Incisor Mesiodistal Rt	8.708	0.789	0.030 *
Maxillary Incisor Mesiodistal Lt	8.620	0.780	
Maxillary Canine Mesiodistal Rt	8.045	0.742	0.522
Maxillary Canine Mesiodistal Lt	8.002	0.720	
Maxillary First Molar Mesiodistal Rt	10.321	0.897	0.390
Maxillary First Molar Mesiodistal Lt	10.385	0.745	
Mandibular Incisor Buccolingual Rt	5.717	0.613	0.595
Mandibular Incisor Buccolingual Lt	5.691	0.562	
Mandibular Canine Buccolingual Rt	6.930	0.661	0.496
Mandibular Canine Buccolingual Lt	6.989	0.709	
Mandibular Molar Buccolingual Rt	10.696	0.595	0.721
Mandibular Molar Buccolingual Lt	10.679	0.595	
Mandibular Incisor Mesiodistal Rt	5.705	0.791	0.553
Mandibular Incisor Mesiodistal Lt	5.724	0.774	
Mandibular Canine Mesiodistal Rt	7.071	0.753	0.482
Mandibular Canine Mesiodistal Lt	7.119	0.721	
Mandibular First Molar Mesiodistal Rt	11.107	1.221	0.399
Mandibular First Molar Mesiodistal Lt	11.155	1.247	

N=51, Paired t-test, * $p \leq 0.05$, ** $p \leq 0.05$ **Table III: Fluctuating asymmetry in Class II malocclusion**

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	7.021	0.720	0.060
Maxillary Incisor Buccolingual Lt	7.098	0.724	
Maxillary Canine Buccolingual Rt	7.743	0.766	0.616
Maxillary Canine Buccolingual Lt	7.768	0.801	
Maxillary First Molar Buccolingual Rt	10.911	0.680	0.056
Maxillary First Molar Buccolingual Lt	11.010	0.673	
Maxillary Incisor Mesiodistal Rt	8.399	0.693	0.140
Maxillary Incisor Mesiodistal Lt	8.458	0.713	
Maxillary Canine Mesiodistal Rt	7.968	0.720	0.444
Maxillary Canine Mesiodistal Lt	7.939	0.677	
Maxillary First Molar Mesiodistal Rt	10.094	0.721	0.545
Maxillary First Molar Mesiodistal Lt	10.037	1.039	
Mandibular Incisor Buccolingual Rt	5.785	0.981	0.896
Mandibular Incisor Buccolingual Lt	5.779	0.995	
Mandibular Canine Buccolingual Rt	6.816	0.677	0.080
Mandibular Canine Buccolingual Lt	6.910	0.722	
Mandibular Molar Buccolingual Rt	10.432	0.575	0.093
Mandibular Molar Buccolingual Lt	10.318	0.754	
Mandibular Incisor Mesiodistal Rt	5.604	1.216	0.679
Mandibular Incisor Mesiodistal Lt	5.621	1.243	
Mandibular Canine Mesiodistal Rt	6.841	0.698	0.001**
Mandibular Canine Mesiodistal Lt	6.974	0.688	
Mandibular First Molar Mesiodistal Rt	10.637	1.422	0.829
Mandibular First Molar Mesiodistal Lt	10.649	1.428	

N=49, Paired t-test, * $p \leq 0.05$, ** $p \leq 0.05$

Table IV: Fluctuating asymmetry in Class I males

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	7.010	0.666	0.488
Maxillary Incisor Buccolingual Lt	7.053	0.572	
Maxillary Canine Buccolingual Rt	7.720	0.650	0.617
Maxillary Canine Buccolingual Lt	7.690	0.659	
Maxillary First Molar Buccolingual Rt	10.925	0.589	0.001**
Maxillary First Molar Buccolingual Lt	11.122	0.568	
Maxillary Incisor Mesiodistal Rt	8.625	0.649	0.154
Maxillary Incisor Mesiodistal Lt	8.550	0.685	
Maxillary Canine Mesiodistal Rt	7.895	0.745	0.618
Maxillary Canine Mesiodistal Lt	7.850	0.660	
Maxillary First Molar Mesiodistal Rt	10.320	0.719	0.722
Maxillary First Molar Mesiodistal Lt	10.298	0.721	
Mandibular Incisor Buccolingual Rt	5.789	0.572	0.524
Mandibular Incisor Buccolingual Lt	5.752	0.497	
Mandibular Canine Buccolingual Rt	6.925	0.590	0.625
Mandibular Canine Buccolingual Lt	6.983	0.690	
Mandibular Molar Buccolingual Rt	10.591	0.527	0.683
Mandibular Molar Buccolingual Lt	10.568	0.480	
Mandibular Incisor Mesiodistal Rt	5.528	0.468	0.252
Mandibular Incisor Mesiodistal Lt	5.569	0.445	
Mandibular Canine Mesiodistal Rt	6.956	0.534	0.423
Mandibular Canine Mesiodistal Lt	6.963	0.542	
Mandibular First Molar Mesiodistal Rt	10.840	1.165	0.423
Mandibular First Molar Mesiodistal Lt	10.633	0.832	

N=17, Paired t-test, * $p \leq 0.05$, ** $p \leq 0.05$ **Table V: Fluctuating asymmetry in Class I Females**

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	7.010	0.666	0.488
Maxillary Incisor Buccolingual Lt	7.053	0.572	
Maxillary Canine Buccolingual Rt	7.720	0.650	0.617
Maxillary Canine Buccolingual Lt	7.690	0.659	
Maxillary First Molar Buccolingual Rt	10.925	0.589	0.001**
Maxillary First Molar Buccolingual Lt	11.122	0.568	
Maxillary Incisor Mesiodistal Rt	8.625	0.649	0.154
Maxillary Incisor Mesiodistal Lt	8.550	0.685	
Maxillary Canine Mesiodistal Rt	7.895	0.745	0.618
Maxillary Canine Mesiodistal Lt	7.850	0.660	
Maxillary First Molar Mesiodistal Rt	10.320	0.719	0.722
Maxillary First Molar Mesiodistal Lt	10.298	0.721	
Mandibular Incisor Buccolingual Rt	5.789	0.572	0.524
Mandibular Incisor Buccolingual Lt	5.752	0.497	
Mandibular Canine Buccolingual Rt	6.925	0.590	0.625
Mandibular Canine Buccolingual Lt	6.983	0.690	
Mandibular Molar Buccolingual Rt	10.591	0.527	0.683
Mandibular Molar Buccolingual Lt	10.568	0.480	
Mandibular Incisor Mesiodistal Rt	5.528	0.468	0.252
Mandibular Incisor Mesiodistal Lt	5.569	0.445	
Mandibular Canine Mesiodistal Rt	6.867	0.590	0.319
Mandibular Canine Mesiodistal Lt	6.959	0.678	
Mandibular First Molar Mesiodistal Rt	11.041	0.808	0.262
Mandibular First Molar Mesiodistal Lt	11.125	0.793	

N=32, Paired t-test, * $p \leq 0.05$, ** $p \leq 0.05$

Table VI: Fluctuating asymmetry in Class II males

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	7.502	0.532	0.054
Maxillary Incisor Buccolingual Lt	7.624	0.628	
Maxillary Canine Buccolingual Rt	8.408	0.765	0.994
Maxillary Canine Buccolingual Lt	8.407	0.742	
Maxillary First Molar Buccolingual Rt	11.339	0.695	0.141
Maxillary First Molar Buccolingual Lt	11.520	0.637	
Maxillary Incisor Mesiodistal Rt	8.627	0.733	0.060
Maxillary Incisor Mesiodistal Lt	8.787	0.857	
Maxillary Canine Mesiodistal Rt	8.339	0.658	0.284
Maxillary Canine Mesiodistal Lt	8.261	0.608	
Maxillary First Molar Mesiodistal Rt	10.380	0.738	0.145
Maxillary First Molar Mesiodistal Lt	10.514	0.755	
Mandibular Incisor Buccolingual Rt	6.181	0.447	0.134
Mandibular Incisor Buccolingual Lt	6.322	0.381	
Mandibular Canine Buccolingual Rt	7.332	0.690	0.413
Mandibular Canine Buccolingual Lt	7.430	0.645	
Mandibular Molar Buccolingual Rt	10.899	0.460	0.748
Mandibular Molar Buccolingual Lt	10.924	0.361	
Mandibular Incisor Mesiodistal Rt	6.085	1.668	0.131
Mandibular Incisor Mesiodistal Lt	5.981	1.768	
Mandibular Canine Mesiodistal Rt	7.295	0.706	0.098
Mandibular Canine Mesiodistal Lt	7.377	0.657	
Mandibular First Molar Mesiodistal Rt	11.175	1.724	0.538
Mandibular First Molar Mesiodistal Lt	11.206	1.685	

N=14, Paired t-test, * $p \leq 0.05$ **Table VII: Fluctuating asymmetry in Class II Female**

Variables	Mean	SD	P -Value
Maxillary Incisor Buccolingual Rt	6.839	0.703	0.243
Maxillary Incisor Buccolingual Lt	6.899	0.662	
Maxillary Canine Buccolingual Rt	7.491	0.605	0.558
Maxillary Canine Buccolingual Lt	7.525	0.687	
Maxillary First Molar Buccolingual Rt	10.749	0.608	0.221
Maxillary First Molar Buccolingual Lt	10.817	0.586	
Maxillary Incisor Mesiodistal Rt	8.313	0.667	0.642
Maxillary Incisor Mesiodistal Lt	8.334	0.618	
Maxillary Canine Mesiodistal Rt	7.828	0.700	0.807
Maxillary Canine Mesiodistal Lt	7.817	0.669	
Maxillary First Molar Mesiodistal Rt	9.986	0.695	0.304
Maxillary First Molar Mesiodistal Lt	9.856	1.082	
Mandibular Incisor Buccolingual Rt	5.635	1.086	0.261
Mandibular Incisor Buccolingual Lt	5.573	1.078	
Mandibular Canine Buccolingual Rt	6.621	0.567	0.124
Mandibular Canine Buccolingual Lt	6.713	0.654	
Mandibular Molar Buccolingual Rt	10.255	0.516	0.061
Mandibular Molar Buccolingual Lt	10.089	0.740	
Mandibular Incisor Mesiodistal Rt	5.422	0.963	0.217
Mandibular Incisor Mesiodistal Lt	5.485	0.973	
Mandibular Canine Mesiodistal Rt	6.670	0.622	0.005 *
Mandibular Canine Mesiodistal Lt	6.822	0.644	
Mandibular First Molar Mesiodistal Rt	10.433	1.256	0.948
Mandibular First Molar Mesiodistal Lt	10.438	1.281	

N=37, Paired t-test, * $p \leq 0.05$

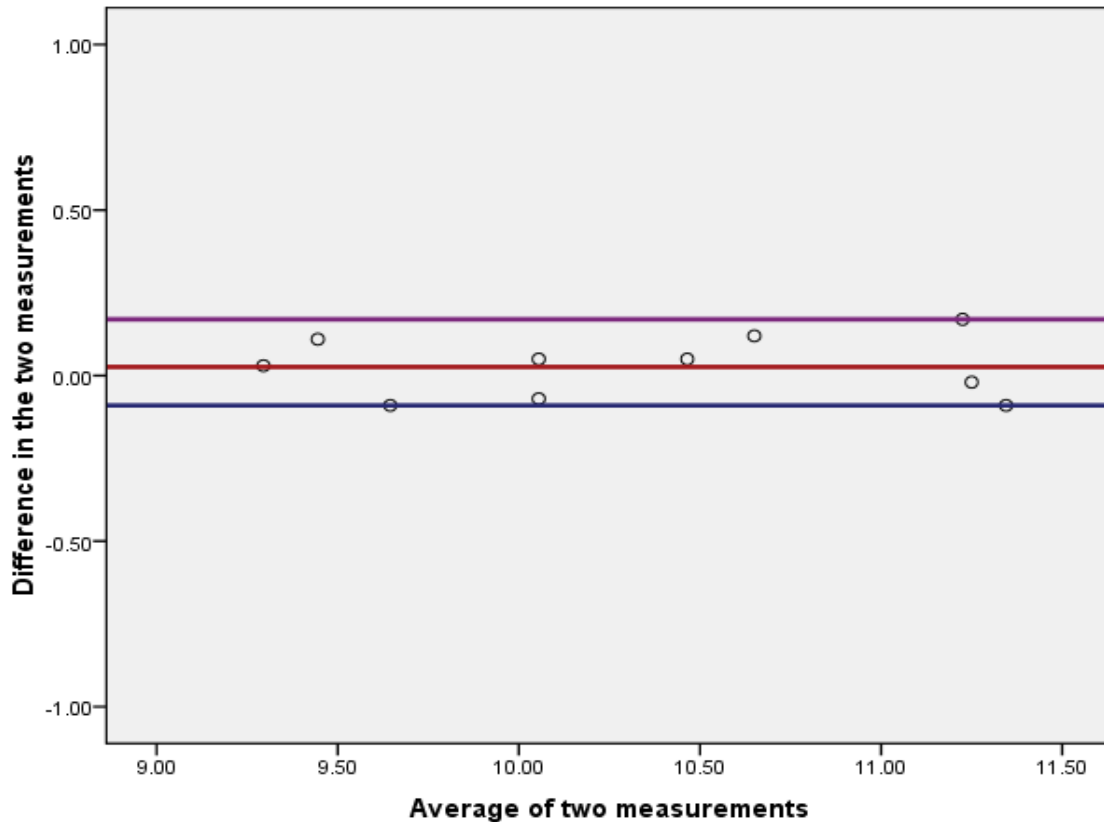


Figure 1: Scatter plot for assessing intra-examiner reliability

Results for assessment of fluctuating asymmetry in Class I and Class II is mentioned in Table II and III. Gender dimorphism results for Class I malocclusion group is shown in Table IV and V, and for Class II malocclusion group in Table VI and VII.

Statistically significant difference was seen in faciolingual width of maxillary first molar and mesiodistal width of maxillary central incisors in Class I malocclusion. However, in Class II malocclusion fluctuating asymmetry was only observed in mesiodistal dimension of mandibular canines.

Fluctuating asymmetry was seen in both males and females in faciolingual width of maxillary first molar in Class I malocclusion. However, in Class II malocclusion, fluctuating asymmetry was observed in females in mesiodistal dimension of mandibular canines.

Bland Altman test was used to assess the intra-examiner reliability. Good intra-examiner reliability existed for the two measurements (Figure 1) with a mean difference of 0.03 (95% confidence interval for the difference -0.09 to 0.026).

Discussion

Analysis of the asymmetry is used as a vital 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 with various malocclusions. Correct initial calculation of tooth size discrepancy helps the orthodontist in choice of best treatment option and management of a specific problem.⁷

The present study was conducted to compare fluctuating asymmetry in subjects having

Angle's Class I and Class II malocclusion and to assess pattern of asymmetry in male and female in both malocclusion groups. In this study 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.⁸ 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. Kula and et al⁹ studies the same phenomenon on 151 children with large over jets. The median palatal plane was considered as reference for transverse measurements and computer generated transverse palatal plane was taken as reference for anteroposterior measurements. Their study results indicated association between fluctuating asymmetry and severity of Class II malocclusion. Greater asymmetry was related with presence of larger over jet and patients with larger over jet had significant amount of intra-arch asymmetry. However, in our study statistically significant fluctuating asymmetry was observed in both Class I and Class II malocclusion groups.

Harris and Bodford¹⁰ studied 211 whites (living in the US Mid-south) with proportionate samples of Class I, II and III malocclusions. They concluded in agreement to Kula et al, that greater dental asymmetry is associated with Class II malocclusions. They also observed that patient gender did not influence the magnitude of asymmetry.

The results of the present study are in contradiction to the studies of Kula et al and Harris et al. In our study we found asymmetry in both Class I and Class II malocclusions and observed gender dimorphism in only Class II malocclusion group.

Gran^{11,12} et al concluded that males are expected to have greater fluctuating asymmetry when compared with females due to x-chromosomal odontogenetic buffering in

females. Nicole¹³ et al also supports the finding of Gran et al in their study and postulated that intrauterine environment is favorable for females therefore they are more resistant to fluctuating asymmetry. This study established that; significant difference was seen in buccolingual dimension of maxillary first molars in both males and females in Class I malocclusion. In contrary, significant asymmetry was seen in females in mesiodistal dimensions of mandibular canines in Class II malocclusion group. Hence, current study results does not support the Gran et al and Nicole et al research work.

Debbie¹⁴ et al studied a single population of Gullah, African Americans from the Outer Banks of South Carolina, living on St. James Island during the 1950's using dental casts of 469 patients. Buccolingual diameter of antimeric pairs of maxillary and mandibular deciduous canines, first molars, second molars and their permanent successors were measured. He observed that female mandibular canines exhibited statistically significantly greater fluctuating asymmetry than those of male group, while there was no statistically significant gender difference found in fluctuating asymmetry for the maxillary canine. Present study is in agreement to the results of Debbie et al. It was found that significant fluctuating asymmetry exists in mesiodistal dimension of mandibular canines in female of Class II malocclusion group.

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 or over emphasized. 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.

Conclusions

Fluctuating asymmetry was observed in both Class I and Class II malocclusions. However, Pattern of fluctuating asymmetry was different in male and female subjects with Class II malocclusion. It is imperative that assessment of fluctuating asymmetry should be done in both Class I and Class II malocclusions irrespective of gender dimorphism, before initiation of orthodontic treatment.

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