

# Asymmetry Assessment for Saudi Adult Male Population: Grummons Analysis

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## ABSTRACT

**Objectives:** The prime aim of the following study is to measure the facial parameters of the horizontal plane, mandibular morphology and linear asymmetries using Grummons analysis (GA).

**Materials and methods:** Standard posterior–anterior cephalogram (PAC) of 100 esthetically pleasing faces without any orthodontic treatment and craniofacial deformity were taken from the radiology archive. All radiographs are digitally analyzed for the GA. Various linear and angular variables were measured for horizontal plane, mandibular morphology, and linear asymmetries.

**Results:** Descriptive analysis has been done using SPSS software. Mean disparities has been calculated to check the difference between different parameters with other ethnics. GA of PAC of Saudi adult male showed variable degrees of facial asymmetry. The lower third of the face showed greater asymmetries. Mandibular deviation, maxillary midline deviations, and mandibular midline deviation are 3.51 mm, 2.52 mm and 2.86 mm, respectively.

**Conclusion:** This study has measured PAC; horizontal plane, mandibular morphology and linear asymmetries for the Saudi adult male using GA. Facial asymmetries are found to have a common finding in Saudi adult male subjects who have normal facial harmony.

**Keywords:** Grummons analysis, Posterior anterior cephalogram, Saudi.

**How to cite this article:** Kumar H, Kundi I, Alam MK. Asymmetry Assessment for Saudi Adult Male Population: Grummons Analysis. World J Dent 2019;10(1):46-51.

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

Asymmetry in the face and dentition is a naturally occurring phenomenon. In most cases, facial asymmetry can only be detected by comparing homologous parts of the face. Mild asymmetry of the facial region is a common finding in a general population and is usually without

noticeable esthetic or functional significance. Asymmetry becomes important when it affects function, esthetics or social acceptance of an individual.<sup>1,2</sup>

The etiology of asymmetry includes:

- Genetic or congenital malformations such as hemifacial microsomia and unilateral clefts of the lip and palate
- Environmental factors such as habits and trauma
- Functional deviations such as mandibular shifts as a result of tooth interferences are common
- Developmental, cause unknown.<sup>3</sup>

Dental asymmetries and a variety of functional deviations can be treated orthodontically. On the other hand, significant structural facial asymmetries are not easily amenable to orthodontic treatment.<sup>4</sup> These problems may require orthopedic correction during the growth period and/or surgical management at a later point.

PAC has been considered as one of the most valuable diagnostic aid for asymmetry evaluation. Various methods<sup>2,5</sup> have been used in literature to assess facial morphology. These analysis are important to find any frontal skeletal asymmetry. And to study the frontal visual treatment objectives as well as to evaluate improvements in facial or dental proportions

For the assessment of facial asymmetries, Grummons and Kappeyne Van De Coppello have developed a major analysis system.<sup>2</sup> Asymmetry rather than determining actual inconsistencies was the prime purpose of GA to identify individual differences, and no normative data were presented in this system. Through comparison of the horizontal plane, mandibular morphology, and linear asymmetries measurements, the attention was to investigate the skeletal and dental components of asymmetry.<sup>6</sup>

Most studies of facial asymmetry have reported that the right hemiface is usually wider than the left; however, fewer studies have reported on the laterality of chin deviation, a subject that also remains controversial.<sup>1,2,4,6,7</sup> Hence, the purpose of this study was to investigate the asymmetry of the face using GA in Saudi adult male subjects and investigate the difference in asymmetry with published data.

## MATERIALS AND METHODS

### Ethical Consideration

This research was approved by the Ethics Committee of CODS10/6/2016. The personal information of participants was anonymized before analysis and was kept confidential.

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- **Study design:** Retrospective study.
- **Subjects:** The present study included standard (PAC) of one hundred Saudi male adults. The average age was  $25 \pm 4$  years. The PAC was selected on the basis of inclusion and exclusion criteria from the radiology archive.
- The inclusion criteria of the subjects consisted of, no previous orthodontic treatment, no craniofacial deformity, no skeletal abnormality or deformity or surgery, both parents and grandparents being Saudi without any interracial marriage. Exclusion criteria are blurred PAC X-ray, subjects with orthodontic treatment and craniofacial deformity, facial or esthetic surgery.
- **Measurements:** All PAC digital tracings were carried out by a single calibrated investigator. Before doing any measurements, examiner underwent intensive training and calibration. 3D-On-Demand software (Seoul, Korea) was used to perform digital analysis in a standard manner. GA does not formulate a normative data of variables measured, however, GA helps determine the skeletal and dental components of asymmetry in a wide range. In this study, the analyses employed according to the GA method 2 are shown in Figure 1 and details are presented in Table 1. All of the

measurements are related to the horizontal plane, mandibular morphology and linear asymmetries (Fig. 1 and Table 1).

### Statistical Analysis

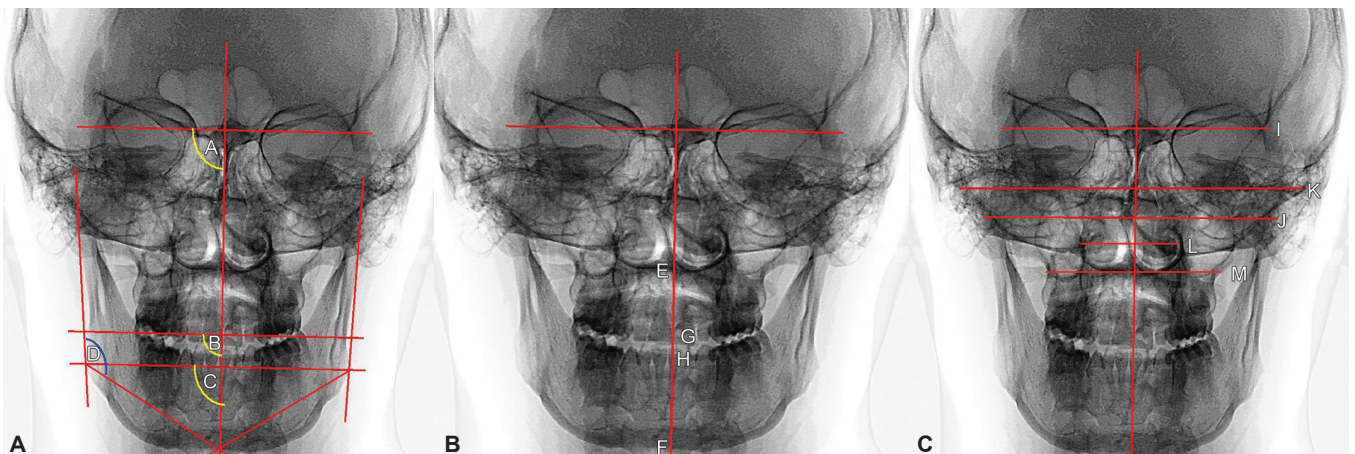
Statistical package for social sciences (SPSS) software version 20 (Chicago, IL, USA) was used for data analysis and the descriptive analysis was carried out.

### Error Analysis

The reliability of the method was analyzed by the Dahlberg's formula on 20% randomly selected PAC. Selected PAC radiographs were redigitized and re-measured to calculate the error in the method after an interval of 3 weeks.

### RESULTS

Normality of distribution of the obtained data are tested by the Kolmogorov-Smirnov test. We found, all the data were normally distributed. Dahlberg's formula results to determine the method-error were not exceeding 0.59 mm for the linear variables, 0.89 degrees for the angular variables.



**Figs 1A to C:** Grummons analysis of PAC of an in the sample (details in Table 1)

**Table 1:** Details of the GA measurements using PAC

Variable	Description
A. Z plane angle	Angle between Z plane and Cg-ANS line
B. Occlusal plane angle	Angle between occlusal plane and Cg-ANS line
C. Antegonial plane angle	Angle between antegonial plane and Cg-ANS line
D. Antegonial angle	Angle between mandibular ramus and mandibular body
E.	Anterior nasal spine deviation
F.	Mandibular deviation
G.	Maxillary dental midline deviation
H.	Mandibular midline deviation
I.	Frontozygomatic suture to X-line distance
J.	Condylion to X-line distance
K.	Zygoma distance
L.	Piriform aperture to X-line distance
M.	Maxilla buttress to X-line distance

Descriptive statistics of the GA for Saudi adult males were generated (Table 2); comparative statistics of mean and mean differences between the Saudi and Indian data were presented (Graph 1).

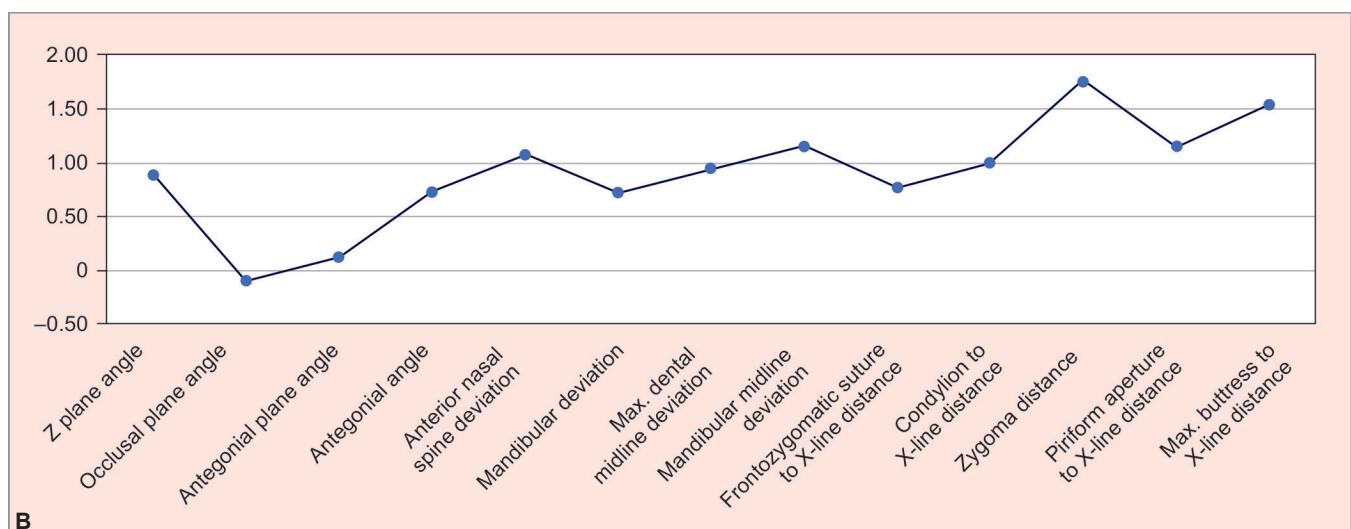
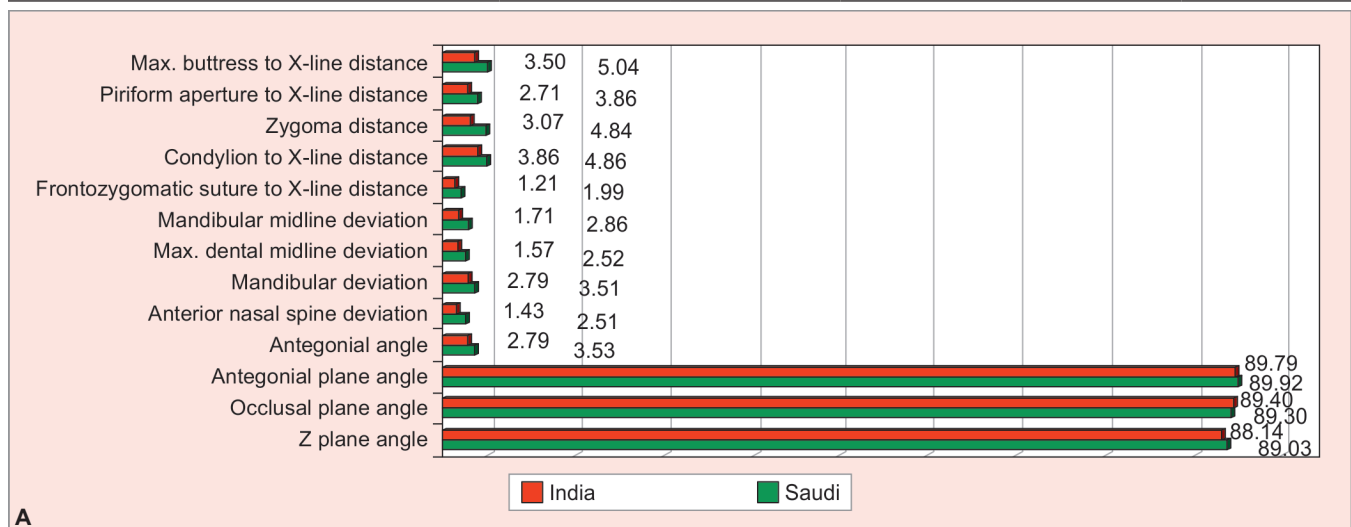
The mean, standard error, standard deviation, range measurement values representing GA angular and linear analysis are shown in Table 2.

## DISCUSSION

The prime aim of this investigation was to evaluate the horizontal plane, mandibular morphology and linear asymmetries parameters based on GA for Saudi adult males. Minor and major asymmetry is an important factor to quantify asymmetry. For clinical and diagnostic purposes during growth and for adults and to

**Table 2:** Descriptive GA measurements of Saudi adult male using PAC

Variable	Mean	SE	SD	Minimum	Maximum
Z plane angle	89.03	0.08	0.84	87.70	90.50
Occlusal plane angle	89.30	0.11	1.12	87.40	91.70
Antegonial plane angle	89.92	0.12	1.17	87.40	91.50
Antegonial angle	3.53	0.03	0.30	2.90	4.20
Anterior nasal spine deviation	2.51	0.03	0.28	1.70	3.00
Mandibular deviation	3.51	0.03	0.29	2.80	4.00
Max. dental midline deviation	2.52	0.03	0.27	2.10	2.90
Mandibular midline deviation	2.86	0.03	0.34	2.30	3.70
Frontozygomatic suture to X-line distance	1.99	0.03	0.34	0.80	2.80
Condylion to X-line distance	4.86	0.02	0.23	4.40	5.40
Zygoma distance	4.84	0.03	0.29	4.20	5.50
Piriform aperture to X-line distance	3.86	0.03	0.26	3.30	4.40
Max. buttress to X-line distance	5.04	0.03	0.28	4.50	5.60



**Graphs 1A and B:** (A) Mean value comparison between Saudi and Indian (7) GA analysis of PAC;  
(B) Mean differences between Saudi and Indian (7) GA analysis of PAC



assess treatment results, quantification is indispensable to visualize the amount of asymmetry. For qualitative analysis of asymmetry, problems of skeletal, dental or soft tissue origin help in the diagnosis and treatment planning.<sup>1</sup> Comprehensive analysis of facial asymmetry of the horizontal plane, mandibular morphology, and linear asymmetries parameters are important in different fields of medicine and dentistry, especially among specialists like plastic and reconstructive surgeons, oral and maxillofacial surgeons, orthodontists, and maxillofacial prosthodontists.

The spectrum of cephalometric analysis procedures have been used to determine the lateral skeletal dental and facial components of normal occlusion and malocclusion individuals of the different population and with varieties of analysis.<sup>8-42</sup> For severe cases, the lateral cephalometric analysis used as an aid in orthodontic diagnosis, treatment planning, and follow-up. However, precise diagnosis of differences in a horizontal plane, mandibular morphology, and linear asymmetries parameters may also require a PAC estimation.

### Angular Measurement

Four angular measurements for adult Saudi males on PAC were carried out. Two measurements are larger and two are quite similar to the PAC values of Indian adults with normal occlusion.<sup>7</sup> Interestingly, both of the larger values are quite similar with the PAC values of Indian adults with class II subdivision malocclusion.<sup>7</sup> These differences may depend on subject selection criteria. PAC of Indian subjects was selected based on dental model criteria, as well as, Saudi PAC are only from an adult male. These may be responsible for the disparities.

### Linear Measurement

Four linear measurements of GA are related to the asymmetry of the lower third of the face. These are anterior nasal spine deviation, mandibular deviation, maxillary dental midline deviation, and mandibular midline deviation. The current study found asymmetries in all four measurements. These results coincide with the previously published researches on Brazilian<sup>43</sup> and Indian<sup>7</sup> PAC. Jabeen et al.<sup>7</sup> found asymmetries in relation to normal occlusion group as well as in the class II subdivision group of malocclusion subjects. Their results are quite similar in both groups. Saudi adults showed even more disparities than the Indian normal and class II subdivision subjects group.<sup>7</sup> These results also coincide with the Brazilian PAC results.<sup>43</sup>

### Linear Asymmetries

All of the five variables of linear asymmetry values for Saudi adult male are greater than PAC values of Indian

normal occlusion subjects.<sup>7</sup> However, Indian class II subdivision malocclusion PAC values for the zygoma distance are even larger than the normal as well as Saudi adult male's data. Condylion to X-line distance data of Indian class II subdivision malocclusion subjects are quite similar to the Saudi adult male's data.

Many kinds of literature published regarding asymmetries using PAC.<sup>4,7,44</sup> They have shown PAC measurements are different from those in normal occlusion and with the malocclusion groups.<sup>4,7,43,44</sup> Asymmetries are common in normal and malocclusion group. Our results also found similarities with previously published literature.<sup>4,43</sup> Major limitations of this study are comparison with the malocclusion group and with the female group was not possible, as all the subjects were selected based on good facial harmony rather than malocclusion grouping and all of the subjects are limited to the male gender. These results are from the subjects of the northern region of Saudi Arabia. Other areas subjects should include to see the possible disparities as well as in different dental and skeletal malocclusion groups.

### CONCLUSION

Based on results following conclusion can be drawn:

- The present data demonstrate GA of means, standard error, standard deviation, and ranges of commonly used PAC parameters for a large, representative sample of adult Saudi male.
- Facial asymmetry was revealed in Saudi adult male based on PAC of GA.
- The findings are very much different with Indian normal occlusion data were found.

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