# *CORRELATION BETWEEN VARIOUS VERTICAL DYSPLASIA ASSESSMENT PARAMETERS*

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## Abstract

**Introduction:** Assessment of vertical jaw relationship is pivotal in orthodontic diagnosis and treatment planning. Different Cephalometric & non-cephalometric methods have been reported to assess the vertical pattern of the patient each having limitations. Purpose of this study was to compare different cephalometric methods used for the assessment of Vertical Skeletal dysplasia.

**Materials and Methods:** Lateral Cephalograms of 72 subjects (44 females & 28 males) with mean age 17.63±4.19 were taken and analyzed by calculating <SNM, <SNP, <SNO, MMA, Y-axis, SOPA, Facial Ratio & Jarback Ratio. Descriptive statistics for each variable was calculated and co-efficient of correlation (r) was calculated among the variables used.

**Results:** Statistically significant and highly correlated relationship was found for the <SNM, <SNO & SOPA with rest of the parameters used to assess the vertical pattern of the patient. MMA showed statistically significant correlation with all the parameters except <SNP. Jaraback Ratio & Facial ratio were independent of each other.

**Conclusion:** 1.Statistically significant correlations were found for <SNM, <SNO & SOPA with all the other parameters used to assess the Vertical jaw discrepancy showing that these parameters could be used interchangeably. 2. <SNP, Jaraback Ratio & Facial ratio should be assessed additionally due to their importance in differential diagnosis.

**Keywords:** Vertical Skeletal Dysplasia, Mandibular Plane Angle, Facial Ratio, Jaraback Ratio

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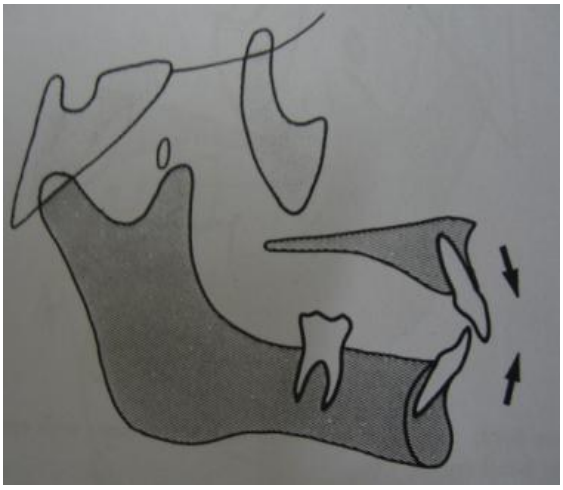
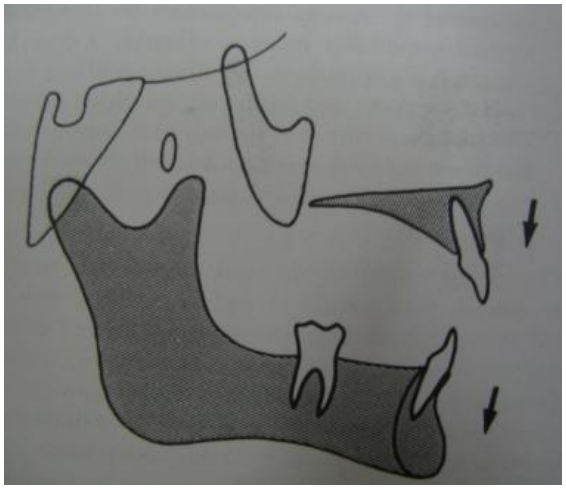
## *INTRODUCTION*

Vertical Jaw relationship means the relationship of maxilla & mandible to cranium in vertical plane. Maxilla & mandible normally grows at an angle of $45^0$ to the cranium in downward and forward direction. Any discrepancy in vertical jaw relationship is termed as Vertical Jaw Dysplasia and is a function of abnormal jaw rotations. Ackerman & Profit Classification classify the two common types of dysplasia in vertical plane i.e. Skeletal Open Bite & Skeletal Deep Bite[1].

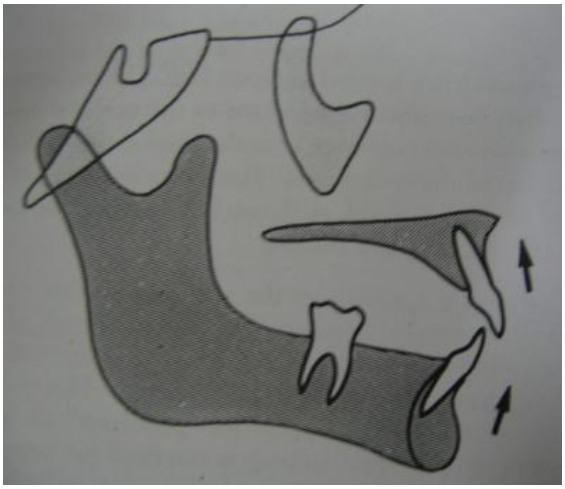
Laveragne and Gasson however gave a detailed concept of jaw rotations in human beings and differentiated following types of jaw rotations in human implant studies: 1. Convergent rotation of jaw basis (This rotation can cause severe skeletal Deep Bite) 2. Divergent rotation of jaw basis (This rotation can cause marked open bite) 3. Cranial rotation of jaw basis (This rotation can cause Less toothy smile) and 4. Caudal rotation of jaws (This rotation can cause Gummy smile)[2.]



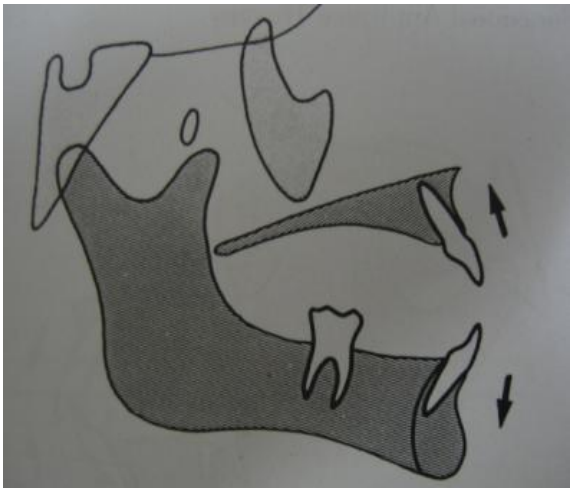
Convergent rotation of jaw basis



Caudal Rotation of Jaw Basis



Cranial Rotation of Jaw basis



Divergent rotation of jaw Basis

Assessment of vertical jaw relationship is pivotal in orthodontic treatment planning as macro-aesthetics, extraction vs non-extraction decision, Anchorage requirements & Surgical vs Non-surgical decision all are dependent on the vertical pattern of the patient. Moreover Therapeutic control of the vertical dimension is usually, more difficult than the control of sagital dimensions.

Different Cephalometric & non-cephalometric methods have been reported to assess the vertical pattern of the patient but the literature does not establish a single proven method for determining the discrepancy in Vertical plane. Different Angular & Linear cephalometric methods have been used to assess the vertical jaw relationship however each one has its on advantages & limitations. <SNM (SN-Mandibular Plane Angle)[2], FMA (Frankfurt Horizontal Plane Angle)[3], MMA (Pal-MP or Maxillo-mandibulat Plane Angle)[2], Facial Axis, Mandibular Arc, LAFH[4] & Mandibular Plane angle and Y-axis[5-7] are among the most popular angular parameters used to assess the overall vertical pattern of the patient while <SNP (SN-Palatal plane Angle) & NCFA[4] determines the contribution of maxilla in creating vertical dysplasia. Among the linear measurements S-PNS (Sella to Posterior Nasal Spine), N-ANS (Nasion to Anterior Nasal Spine), N-Me (Nasion to Menton), ANS-Me (Anterior Nasal Spine to Me), S-Go ( Sella to Gonion), Facial Ratio & Jaraback Ratio[8,9] are popular. However non of these is absolute in assessing the discrepancy and one can have different values for some of these variable for the same patient thus causing problem in diagnosis and thus in treatment planning. Aim of this study was to assess the Vertical jaw relationship using widely used cephalometric methods and to establish their correlation.

## *OBJECTIVES*

The objectives of this study are to:

1. Assess the vertical jaw relationship using different cephalometric methods.

2. Correlate different cephalometric methods used in assessing the Vertical jaw relationship

## MATERIALS AND METHODS

The study was conducted on 72 subjects (44 females, 28 males) with age range of 12-30 years who reported at de`Montmorency College of Dentistry & Faculty of Dentistry, The University of Lahore. Subjects having supernumerary or congenitally missing teeth, already undergoing with orthodontic treatment and Syndromes, were excluded from the study Sample was collected using the non-probability convenience sampling technique.

Lateral Cephalogram was taken in natural head position for each subject. Lateral Cephalogram was then traced and analyzed for each patient. SN Plane to Mandibular Plane Angle (<SNM $32^0 \pm 4$), SN Plane to Palatal Plane Angle (<SNP $6^0 \pm 4$), SN Plane to Occlusal Plane Angle (<SNO $17^0 \pm 4$), Angle between Maxillary plane & Mandibular plane (MMA $25^0 \pm 4$), Sum of Posterior Inner Angles (SOPA $392^0 \pm 4$), Y-axis $66^0 \pm 4$, Facial Ratio ($54\% \pm 4$) & Jaraback Ratio ($65\% \pm 4$) were calculated on Cephalogram. Predictability of each parameter was then assessed in identifying the vertical pattern of the patient & different values were correlated.

## STATISTICAL METHODS

SPSS 10.0 was used for statistical evaluation.

1. *Mean, Standard Deviation, Minimum & Maximum value and Range were calculated for each parameter for each subject.*

2. *Correlation coefficients between the various parameters were calculated using Pearson's correlation.*

## RESULTS

The study was conducted on 72 subjects (44females & 28 males) with mean age $17.63 \pm 4.19$. Descriptive Statistics were calculated for each variable for each subject as shown in table I.

Statistically significant and highly correlated relationship was found between the <SNM & rest of the seven parameters used to assess the vertical pattern of the patient, however statistically significant but negative correlation exists between <SNM & Jaraback Ratio. <SNP has statistically insignificant correlation with MMA and Facial Ratio. Facial Ratio is also statistically insignificantly related with Jaraback Ratio as shown in table II.

Descriptive Statistics were also calculated for males & females separately for each cephalometric variable as shown in table III. Correlations between various parameters used to assess the vertical parameters was also calculated for males as shown in table IV and for females as shown in table V

***Table I***

**N=72 (ENTIRE DATA)**

| | Range | Min. | Max. | Mean | S. D |
|---|---|---|---|---|---|
| AGE | 18.00 | 12.00 | 30.00 | 17.63 | 4.19 |
| SNM | 35.00 | 19.00 | 54.00 | 34.20 | 7.65 |
| SNP | 16.00 | 1.00 | 17.00 | 9.104 | 3.41 |
| SNO | 29.00 | 2.00 | 31.00 | 17.75 | 6.02 |
| MMA | 31.00 | 10.00 | 41.00 | 25.15 | 6.97 |
| SOPA | 49.00 | 377.00 | 426.00 | 394.84 | 9.48 |
| FCR | 20.20 | 47.50 | 67.70 | 56.70 | 3.79 |
| JBR | 25.80 | 51.40 | 77.20 | 65.32 | 5.85 |
| YAXIS | 19.50 | 57.50 | 77.00 | 68.38 | 4.06 |

***Table II***

| | **SNP** | ***SNO*** | **MMA** | **SOPA** | **FCR** | ***JBR*** | **YAXIS** |
|---|---|---|---|---|---|---|---|
| SNM | .237* | .168** | .858** | .866** | .368** | -.666** | .641** |
| SNP | | .307** | .162 | .234* | .038 | -.281* | .245* |
| SNO | | | .432** | .552** | .320** | -.352** | .500** |
| MMA | | | | .770** | .452** | -.503** | .479** |
| SOPA | | | | | .306** | -.619** | .559** |
| FCR | | | | | | -.081 | .235* |
| JBR | | | | | | | .424** |

***Table III***

**Male N=28**

**Descriptive Statistics**

| | N | Range | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| AGEM | 28 | 18.00 | 12.00 | 30.00 | 19.3929 | 4.9392 |
| SNMM | 28 | 27.00 | 21.00 | 48.00 | 33.3929 | 7.6417 |
| SNPM | 28 | 16.00 | 1.00 | 17.00 | 9.0536 | 3.2011 |
| SNOM | 28 | 22.00 | 7.00 | 29.00 | 17.3929 | 5.8268 |
| MMAM | 28 | 30.00 | 10.00 | 40.00 | 24.1964 | 6.7252 |
| SOPAM | 28 | 37.00 | 378.00 | 415.00 | 393.6786 | 9.2578 |
| FCRM | 28 | 12.90 | 50.00 | 62.90 | 57.1271 | 3.1355 |
| JBRM | 28 | 25.80 | 51.40 | 77.20 | 65.7007 | 6.6614 |
| YAXISM | 28 | 15.00 | 61.00 | 76.00 | 68.4643 | 3.9859 |
| Valid N (listwise) | 28 | | | | | |

**Female N=44**

**Descriptive Statistics**

| | N | Range | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|
| AGEF | 44 | 13.00 | 12.00 | 25.00 | 16.5136 | 3.2204 |
| SNMF | 44 | 35.00 | 19.00 | 54.00 | 34.7273 | 7.7064 |
| SNPF | 44 | 15.00 | 2.00 | 17.00 | 9.1364 | 3.5721 |
| SNOF | 44 | 29.00 | 2.00 | 31.00 | 17.9886 | 6.1997 |
| MMAF | 44 | 30.00 | 11.00 | 41.00 | 25.7614 | 7.1361 |
| SOPAF | 44 | 49.00 | 377.00 | 426.00 | 395.5795 | 9.6575 |
| FCRF | 44 | 20.20 | 47.50 | 67.70 | 56.4370 | 4.1725 |
| JBRF | 44 | 21.77 | 54.83 | 76.60 | 65.0855 | 5.3384 |
| YAXISF | 44 | 19.50 | 57.50 | 77.00 | 68.3409 | 4.1523 |
| Valid N (listwise) | 44 | | | | | |

*Table IV*

**Correlation between various parameters used to assess the vertical pattern of the male patient**

**Male**

**Correlations**

| | SNPM | SNOM | MMAM | SOPAM | FCRM | JBRM | YAXISM |
|---|---|---|---|---|---|---|---|
| SNMM | .319 | .735** | .847** | .886** | .204 | -.547** | .629** |
| SNPM | | .447* | -.050 | .304 | -.371 | -.401* | .240 |
| SNOM | | | .482** | .677** | .110 | -.327 | .622** |
| MMAM | | | | .747** | .386* | -.309 | .479** |
| SOPAM | | | | | .165 | -.517** | .585** |
| FCRM | | | | | | .177 | .379* |
| JBRM | | | | | | | -.224 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

***Table V***

**Correlation between various parameters used to assess the vertical pattern of the Female patient**

**Female**

**Correlations**

| | SNPF | SNOF | MMAF | SOPAF | FCRF | JBRF | YAXISF |
|---|---|---|---|---|---|---|---|
| SNMF | .191 | .547** | .863** | .853** | .465** | -.764** | .655** |
| SNPF | | .233 | -.225 | .196 | .062 | -.203 | .248 |
| SNOF | | | .400** | .479** | .425** | -.374* | .434** |
| MMAF | | | | .779** | .506** | -.651** | .485** |
| SOPAF | | | | | .389** | -.702** | .551** |
| FCRF | | | | | | -.245 | .171 |
| JBRF | | | | | | | -.584** |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

## DISCUSSION

Different methods have been used to assess the vertical pattern of the patient in different analysis & it was found that some of the values differ in interpretation even in the same individual thus making the diagnosis difficult[10-12]. Moreover different variables have been used to assess the contribution of different parts in the development of vertical skeletal dysplasia so that right area of fault can be assessed and then can accordingly be addressed at the time of treatment planning.

Down used Mandibular Plane Angle ($22^0 \pm 3.2$) & Y-axis ($60^0 \pm 3.8$) in his popular analysis to assess the vertical pattern of the patient. In our study <SNM came out to be ($34.21^0 \pm 7.66$) & Y-axis as ($68.39^0 \pm 4.06$). The reason for this difference was that different mandibular

planes were used in the studies[5-7]. Steiner's however found <SN-GoGn as 32°± 4 which was quite similar to our study as the mandibular plane used were similar. Steiner also used <SN-Occl (14°± 4) in his analysis to assess the role of occlusal plane in causing vertical dysplasia. In our study <SN-Occ (<SNO) was found to be 17.7 °±6.02. Slight difference found in the two studies was due to different races being assessed[13-16]. Bjork-Jaraback`s Polygon assessed vertical pattern of the patient by finding out sum of posterior inner angles (396°± 6) & Jarabak Ratio (65% ±4). The values were comparable to the values 394.840±9.48 & 68.39±4.06 found in our study[8]. Norms for MMA (25°±4) & <SNP (6°±4) were comparable to the values 25.15±6.97 & 9.10±3.41respectively found in our study.

Correlation between different variables used to assess the vertical pattern of the patient was also calculated in an attempt to find out the predictability of different variables and to assess whether theses variables can be used in place of each other or not. The results of the study showed that Statistically significant Correlation was found between the <SNM and the rest of the seven variables used in the study, however the statistically significant but negative correlation was found between <SNM & Jaraback` Ratio. <SNO & SOPA (Sum of Posterior angles) also showed statistically significant correlations with the rest of the variables except with jaraback ratio (Ratio between posterior facial Height & Total Anterior Facial Height) for which statistically significant but negative correlation existed. Facial Ratio (Ratio between Lower Anterior Facial Height & Total Anterior facial Height) showed statistically insginficant relation with Jarback ratio as expected. <SNP (Angle between SN plane & Palatal Plane) measures the contribution of maxilla in vertical dysplasia, interestingly MMA has statistically insignificant relation with <SNP. No other study has compared the efficacy of these variables.

Thus it is concluded from the study that SNM, SOPA, SNO have statistically significant correlations with each other and thus there is no need to calculate each of these variables for every patient. <SNP is diagnostic for assessment of role of Maxilla in causing Skeletal Vertical Dysplasia, while Facial Ratio determines the contribution of Lower Anterior Facial Height & Jaraback ratio determines contribution of Posterior Facial Height in causing Skeletal Dysplasia and thus these values needed to be calculated for each patient to eliminate the error in diagnosis.

## *CONCLUSION*

Following conclusions can be drawn from this study:

1. Statistically significant correlations were found for <SNM, <SNO & SOPA with all the other parameters used to assess the Vertical jaw discrepancy showing that these parameters could be used interchangeably.

2. SNP, Jaraback Ratio & Facial ratio should be assessed due to the importanc in differential diagnosis

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