Research Article

Growth Pattern in Skeletal Class I Malocclusion: A Cephalometric Study

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ABSTRACT

Introduction: Great emphasis has been given to the evaluation of sagittal apical base relationship in orthodontic diagnosis and treatment planning. The prediction of magnitude and direction of facial growth based on sagittal relationship will help in orthodontic treatment with growth modification. The objective of the study is to assess the growth pattern in skeletal Class I malocclusion.

Materials and Method: 104 subjects (52 male and 52 female) with the age between 18-30 years with Class I skeletal relation was selected from lateral cephalograms of patients visiting the Department of Orthodontics, Kantipur Dental College. The ANB angle was measured to assess the sagittal jaw relationship and the Jarabak's ratio to access the growth pattern. Descriptive statistics were calculated for each parameter. Pearson's test was done to evaluate the correlation between the parameters. Independent t-test was done to compare Anterior Facial height (AFH), Posterior Facial Height (PFH) and Jarabak's ratio between male and female subjects.

Result: Among the total subjects with skeletal Class I malocclusion; hyperdivergent growth pattern was least (10.57%), followed by normodivergent (18.26%) and hypodivergent growth pattern (71.15%). Mean Jarabak's ratio for hyperdivergent, normodivergent and hypodivergent growth pattern were 58.65±1.94, 63.98±0.85 and 69.98±4.13 respectively. Very strong correlation was found between AFH and PFH in hyperdivergent ($r = 0.821$) and normodivergent group ($r = 0.978$). Strong correlation was found in hypodivergent group between AFH and PFH ($r = 0.743$). Also, strong correlation was found in hypodivergent group between PFH and Jarabak's ratio ($r = 0.643$).

Conclusion: Hypodivergent growth pattern was the dominant growth pattern in skeletal Class I malocclusion. PFH influenced the determination of Jarabak's ratio more than the AFH in hypodivergent growth pattern. Hypodivergent growth pattern is correlated with large SNB angle.

KEYWORDS: Hypodivergent, Hyperdivergent, Jarabak's Ratio, Growth pattern, sagittal relationship

INTRODUCTION

Cephalometry is an important diagnostic tool to determine the relationship between skeletal, dental and soft tissue of the face. It makes assessment of malocclusion possible in anteroposterior[1] and vertical dimension.[2] Cephalometric analysis helps to analyze the influence of vertical changes in the severity of malocclusion in anterior-posterior direction.[3]

"ANB angle" is the most commonly used parameter which relates jaws to anterior cranial base (SN) plane and detects antero-posterior jaw relationship.[4] According to Schudy, the hyperdivergent and hypodivergent growth pattern have implications not only in vertical plane, but also in antero-posterior plane of space. The vertical growth tends to carry the pogonion downward, while antero-posterior growth carries it forward.[5] Thus, the skeletal malocclusion tends to influence the growth pattern.[6]

Numerous techniques have been used to evaluate the vertical relation of the craniofacial region. Tweed introduced the Frankfort mandibular plane angle.[7] Björk related the maxillary and mandibular planes to the S-N plane.[8] Further, Riedel measured the inclination of the mandibular plane to cranium[9] and Downs measured the Y-axis and mandibular plane angles.[10] Wylie and Johnson emphasized the importance of vertical relation and measured the total facial height, upper facial height, condylar angle and ramal height.[11] Steiner measured the inclination of occlusal plane to the cranium,[12] while Ricketts determined vertical relation using the mandibular arc, facial axis angle, mandibular plane angle and lower facial height.[13] Jarabak measured the facial heights and determined the Jarabak ratio in addition to relating Y-axis and the mandibular plane to S-N plane.

The Jarabak ratio determines the percentage of the anterior and posterior facial proportions. Values between 62-65% indicate a well-balanced face, a higher percentage is seen in low angle cases, whereas lower percentage is suggestive of high angle cases.[14] Nahidh et al in their study reported that the vertical relation is better measured by the sum of posterior angles and the Jarabak ratio.[15]

The objectives of this study were to determine the growth pattern in skeletal Class I malocclusion using Jarabak's ratio and to find the correlation between angular and linear parameters. Limited research has been done in Nepali subjects on growth pattern present in skeletal Class I malocclusion. The information obtained from this study will help clinicians comprehend the growth pattern with the malocclusion. Vertical facial changes influence mandibular position and rotation, either clockwise or counterclockwise, thereby contributing to the development of deep or open bite. Thus, growth pattern should be taken into consideration during diagnosis and treatment planning.

MATERIALS AND METHOD

The present study is a non-interventional, cross-sectional study using secondary data. It was conducted at the Department of Orthodontics, Kantipur Dental College Teaching Hospital & Research Center, Kathmandu during September to December 2020 after obtaining the ethical clearance from the Institutional Review Committee.

The sampling technique was non-probability convenience sampling. The sample size was determined based on the number of patients who sought orthodontic treatment at the Department of Orthodontics in reference to study done by Acharya et al[16] using the following formula:

$$\text{sample size (n)} = \frac{\frac{z^2pq}{e^2}}{[1 + \frac{z^2pq}{e^2.N}]}$$

Where, z = 1.96, p = 79.33%, q = 20.67%, e = 0.05 (5%), and N = number of patients visiting the department with Skeletal Class I relation in a period of 6 months = 150.

Lateral cephalograms were visually inspected from the records of the patients seeking orthodontic treatment. A total of 104 lateral cephalograms were traced which included 52 males and 52 females. Independent variables were age and gender groups while dependent variables were cephalometric parameters.

Samples were selected on the basis of the inclusion criteria. Nepali subjects aged 18-30 years with skeletal Class I relation (ANB: 2±2°) having full complement of teeth (excluding third molars) were included in the study. Only high-quality pretreatment lateral cephalograms and panoramic radiographs were evaluated. Subjects who had previously undergone orthodontic or dentofacial orthopedic treatment, history of trauma to craniofacial region, gross craniofacial asymmetry, deformities were excluded from the study.

Lateral cephalograms were previously taken following the standard radiographic protocol. The radiographs were traced on matte acetate tracing paper with 2B sharp pencil on a view box using trans-illuminated light. The landmarks and measurements were marked manually by a single observer (Principal Investigator). Cephalometric landmarks used in the study were Point A, Point B, Sella (S), Nasion (N), Gonion (Go) and Menton (Me).

Cephalometric angular parameters used in the study were SNA, SNB and ANB. Cephalometric linear parameters were Anterior facial height (N-Me) and Posterior facial height (S-Go). (Figure 1).

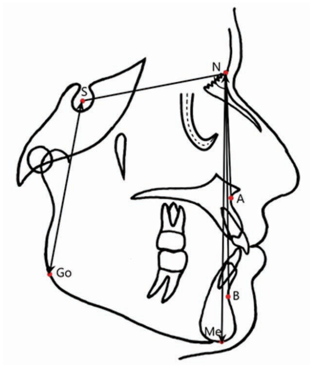


Figure 1: Cephalometric landmarks and parameters

To assess the growth pattern, Jarabak Ratio or Facial Height Ratio (FHR) or Jarabak quotient is then calculated using the following formula[3]

$$\text{Jarabak Ratio} = \frac{\text{Posterior Facial Height (S-Go)}}{\text{Anterior Facial Height (N-Me)}} \times 100$$

After the Jarabak's ratio was calculated the growth pattern was determined based on the following range[14]

1. Normodivergent growth pattern-Jarabak ratio: 62-65%
2. Hypodivergent growth pattern-Jarabak ratio: greater than 65%
3. Hyperdivergent growth pattern-Jarabak ratio: lesser than 62%

Data was collected, compiled and analyzed using SPSS V. 21. To check the normality of the distribution of data, Shapiro Wilk test was done. The data was found to be normally distributed. The descriptive statistics of linear and angular parameters were evaluated. Descriptive statistics including mean, standard deviation and range was calculated for each parameter. Pearson's test was done to evaluate the correlation among the parameters. Independent t-test was done to compare AFH, PFH and Jarabak's ratio between male and female subjects. p-Value <0.05 were considered significant.

RESULT

Table 1. Descriptive statistics of linear and angular parameters

Growth pattern	Parameters	Mean±SD	Maximum	Minimum	Range
Hyperdivergent (n=11)	SNA (°)	78.27±3.77	85.00	74.00	11.00
	SNB (°)	75.50±3.45	82.00	72.00	10.00
	AFH	114.09±6.56	123.50	103.50	20.00
	PFH	66.86±3.28	72.00	60.50	11.50
	Jarabak's ratio	58.65±1.94	61.39	55.91	5.47
Normodivergent (n=19)	SNA (°)	81.78±3.58	89.00	74.00	15.00
	SNB (°)	79.60±3.99	88.00	70.50	17.50
	AFH	112.50±6.92	126.50	103.00	23.50
	PFH	71.97±4.64	79.50	65.50	14.00
	Jarabak's ratio	63.96±0.87	64.91	62.38	2.53
Hypodivergent (n=74)	SNA (°)	81.87±3.56	90.50	74.00	16.50
	SNB (°)	79.91±3.47	88.50	72.50	16.00
	AFH	108.94±7.12	130.50	95.00	35.50
	PFH	75.96±6.39	91.00	64.00	27.00
	Jarabak's ratio	69.73±3.94	84.65	65.20	19.45

Table 2. Comparison of AFH, PFH and Jarabak's ratio between male and female subjects among different growth pattern

Growth pattern	Parameters	Mean±SD		p Value
		Male	Female	
Hyperdivergent	AFH (mm)	113.25±7.75	114.57±6.40	0.783 (NS)
	PFH (mm)	67.50±3.02	66.50±3.60	0.638 (NS)
	Jarabak's ratio (%)	59.68±1.88	58.07±1.85	0.217 (NS)
Normodivergent	AFH (mm)	115.00±6.22	109.72±6.91	0.100 (NS)
	PFH (mm)	73.70±3.91	70.05±4.83	0.093 (NS)
	Jarabak's ratio (%)	64.09±0.75	63.83±1.01	0.538 (NS)
Hypodivergent	AFH (mm)	111.15±4.90	106.61±8.34	0.005*
	PFH (mm)	79.07±5.29	72.68±5.83	0.000*
	Jarabak's ratio (%)	71.18±4.40	68.20±2.70	0.001*

*Significant at p<0.05, NS – Not Significant

Table 3. Pearson correlation test to determine relation between the parameters

Measurements		Hyperdivergent	Normodivergent	Hypodivergent
SNA vs AFH	r Value	0.113	0.059	-0.001
	p value	0.741	0.810	0.990
SNA vs PFH	r Value	0.064	0.065	0.132
	p value	0.852	0.793	0.263
SNB vs AFH	r Value	0.300	0.029	0.009
	p value	0.371	0.907	0.937
SNB vs PFH	r Value	0.187	0.009	0.177
	p value	0.582	0.970	0.132
AFH vs PFH	r Value	0.821	0.978	0.743
	p value	0.002**	0.000**	0.000**
SNA vs Jarabak's ratio	r Value	-0.084	0.059	0.208
	p value	0.805	0.810	0.075
SNB vs Jarabak's ratio	r Value	-0.230	-0.067	0.263
	p value	0.497	0.785	0.024*
AFH vs Jarabak's ratio	r Value	-0.520	0.135	-0.032
	p value	0.101	0.581	0.784
PFH vs Jarabak's ratio	r Value	0.060	0.337	0.643
	p value	0.862	0.158	0.000**

** Correlation significant at $p < 0.05$, * Correlation significant at $p < 0.01$

Strength of correlation coefficient (r) was estimated as follow:[17]

0.8-1 – very strong
0.6-0.79 – strong
0.4-0.59 – moderate
0.2-0.39 – weak and
0-0.19 – very weak

Figure 2: Distribution of growth pattern in skeletal class I malocclusion

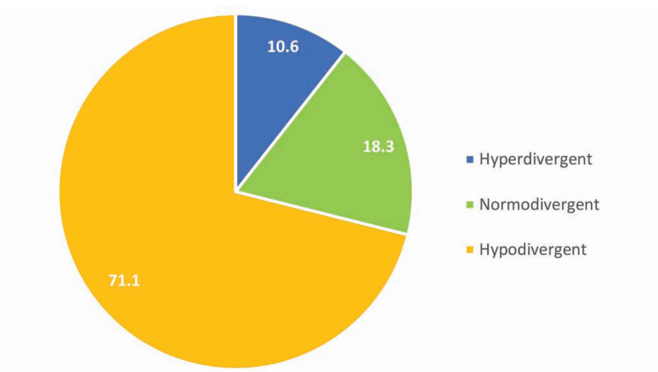
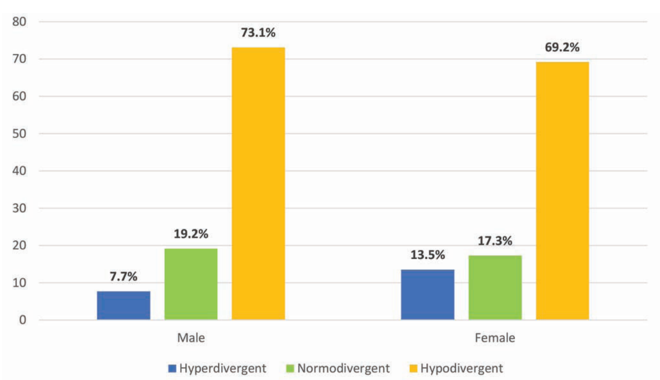


Figure 3: Distribution of growth pattern among male and female



RESULT

The sample consisted of 104 lateral cephalograms of the subjects aged 18 -30 years. The mean age of the total sample was 21.59 ± 3.21 years. There were equal proportion of male and female samples in each group. Descriptive statistics of linear and angular parameters are given in Table 1. The results from Independent t-test and Pearson's correlation test are given in Table 2 and Table 3 respectively.

The mean values of SNA, SNB, AFH, PFH and Jarabak's ratio were 81.47±3.72°, 79.38±3.78°, 110.14±7.22mm, 74.27±6.53mm and 67.51±5.07% respectively (Table 1). The mean values of the same in male and female samples among hyperdivergent, normodivergent and hypodivergent growth pattern are given in Table 2. Gender dimorphism was evident only in hypodivergent growth pattern with respect to AFH, PFH and Jarabak's ratio. There was a very strong positive correlation between AFH and PFH in hyperdivergent (r=0.821) and normodivergent (r=0.978) growth pattern, whereas there was a strong positive correlation between AFH and PFH in hypodivergent (r=0.743) growth pattern. Strong positive correlation was also seen between PFH and Jarabak's ratio but only in hypodivergent (r=0.643) growth pattern.

DISCUSSION

Jarabak's ratio determines the percentage of the anterior and posterior facial proportions. In the present study, skeletal Class I malocclusion demonstrated 10.6% hyperdivergent, 18.3% normodivergent and 71.1% hypodivergent growth pattern. This was similar with the study done by Lall et al[18] in which angle Class I malocclusion demonstrated 11.1% hyperdivergent, 16.7% normodivergent and 72.2% hypodivergent growth pattern. Similar results were also obtained in the study done by Padarthi et al.[19] The findings in this study differs from the study done by by Siriwat and Jarabak,[6] they found normodivergent growth pattern dominant in Class I whereas, in the present study hypodivergent growth pattern was more dominant in skeletal Class I subjects. These discrepancies might be due to racial variation.

The mean posterior facial height of female was less when compared to male to result obtained by Maskey and Shrestha,[20] Taner et al.[21] Wang et al[22] found that PFH rather than AFH play a key role in the vertical facial type. This was true in the present study too, but only in hypodivergent group, as PFH was correlated to Jarabak ratio only in hypodivergent group. Gender dimorphism was also apparent in hypodivergent group with respect to AFH, PFH and Jarabak's ratio. Siriwat and Jarabak[6] found that the gender dimorphism was lowest among Class I malocclusion.

Siriwat and Jarabak[6] found that hyperdivergent face was associated with lesser SNB angle and hypodivergent face was associated with greater SNB angle. In the present study, SNB showed weak correlation with Jarabak's ratio in hypodivergent group.

The study was conducted using lateral cephalogram of patients with skeletal Class I malocclusion in Kantipur Dental College and Hospital. This does not represent a wider range of population. Further research including all skeletal malocclusion would give more detailed and precise information regarding growth pattern in various skeletal malocclusion.

CONCLUSION

Hypodivergent growth pattern was the dominant growth pattern in skeletal Class I malocclusion followed by normodivergent and hyperdivergent growth pattern. PFH influenced the determination of Jarabak's ratio more than the AFH in hypodivergent growth pattern. Hypodivergent growth pattern is correlated with large SNB angle.

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