Original Research Article

TO ASSESS THE SKELETAL DISCREPANCIES BY DETERMINING “R” ANGLE IN LATERAL CEPHALOMETRICS IN NAVI MUMBAI POPULATION.

ABSTRACT

There is considerable interest in the area of orthodontics in malocclusions caused by vertical discrepancies because of their causes, diagnosis, treatment planning, and tendency to return after treatment. Hence, this study aimed to assess, evaluate and check reliability for vertical skeletal discrepancy by establishing a parameter 'R angle' in Navi Mumbai population.
In this study, the lateral cephalometric radiographs of 135 orthodontic patients between the age group of 18-30 years of age were selected from the database of the Department of Orthodontics and Dentofacial Orthopaedics in D Y Patil University School of Dentistry, Navi Mumbai
The study found that the R angle is clinically and statistically important when examining vertical skeletal discrepancies. So with the above results it is observed that R angle can be used to assess vertical skeletal discrepancy in Navi Mumbai population. Along with other parameters it can be important and valuable tool for orthodontist to determine skeletal discrepancies in vertical plane.

Keywords:

INTRODUCTION

There is considerable interest in the area of orthodontics in malocclusions caused by vertical discrepancies because of their causes, diagnosis, treatment planning, and tendency to return after treatment.[1] It is essential for an orthodontist to recognise and comprehend the interrelationships of its many components.[1] Growth in the vertical dimension is the fastest and longest-lasting, making it a distinct feature of the overall design concept. Because growing tends to increase vertical distance between maxillary and mandibular jaw bases, therapy at this period is most desirable, as mentioned by Rakosi.[2] He also states that vertical dimension is not stable. Late growth of the mandible may increase an already existing increase in vertical dimension, accentuating the malocclusion thus occurring due to the discrepancy[2].

Vertical malocclusions develop due to interaction of many different etiological factors; most importantly mandibular growth. An open bite malocclusion can be caused by habits such as thumb sucking and an irregular tongue resting posture, as well as excessive vertical development of the face[3]. Growth processes associated with vertical malocclusions must be understood along with normal and abnormal functioning of the soft tissues, i.e. the lips and the tongue, in order to successfully diagnose and plan treatment for such cases[1]. Growth prediction of the mandible will therefore be of great importance to the treatment plan. It is the condylar and mandibular growth patterns that determine whether a person has a deep or open bite[1]. Björk and Skieller[4] revealed that the lower jaw grows in a variety of directions. The mandibular condyle's upward and forward expansion typically results in a lower face height and a deep bite in patients. The direction of the mandibular growth expressed at the chin, is vertical[5]. A mandible that grows inward and backward, known as the "long-face syndrome," is a common occurrence in these patients. The rear teeth usually emerge vertically in tandem with the rest of the mouth[1].

The problem of a vertical discrepancy is multifactorial. As a result, accurate diagnosis is essential for dental and skeletal structural treatment[1]. In addition, growth patterns, unpredictability, and timing are critical concepts. [1] In diagnosing a malocclusion in the vertical dimension, it is important not to concentrate on one aspect of the patient's overall condition to an extent that other significant features may be overlooked [1]. Orthodontic malocclusions are almost always the culmination of a developmental process and not of a pathologic process[1]. Patients' facial skeleton patterns in the vertical, horizontal and transverse directions are useful in orthodontic diagnosis and treatment planning when they are accurately assessed. [6] Multiple researchers have worked tirelessly over the years to identify the most stable and dependable landmarks for evaluating skeletal discrepancies in various directions, leading to several angular and linear metrics being developed.[6]

Orthodontists consider the vertical shape of a person's face while doing an evaluation. Variations in the vertical dimension can have a significant impact on the clinician's ability to successfully diagnose, plan and carry out successful treatment and mechanics. (Nanda[7]

1988). FMA is a set of preexisting metrics for evaluating vertical skeletal disparities. [8], Y axis[9], GoGn-SN angle[10], Facial axis angle[11] and Jarabak ratio[12].

In Tweeds analysis[8], When the Frankfort horizontal plane intersects with the mandibular plane, a Frankfort mandibular plane angle is generated. Skeletal disparity can be measured at this angle. The average angle is 25 degrees, with lower values indicating lower angle cases and higher values indicating higher angle cases.

Y axis in Downs analysis[9] Forms at Sella-Gnathion Line/Frankfort Horizontal Plane Intersection Faces with an average facial pattern have 59.4 degrees as a standard deviation. High angle instances have larger angles, while low angle cases have smaller angles. Class II facial patterns have larger angles, while Class III patterns have smaller angles.

In Steiner's analysis[10], Mandibular plane intersected with the S-N plane, resulting in the GoGn-SN angle. A 32-degree angle is seen on a well-balanced face, with a higher angle indicating a higher angle and a lower angle indicating a lower angle.

In McNamara analysis[11], junction of Basion - Nasion line and Pterygomaxillary - Gnathion line forming the Facial axis angle. Because it is perpendicular to the Basion-Nasion line, a balanced face has its Facial Axis Angle at 90 degrees. A negative number, such as a 90-degree deduction from the measured angle, indicates that the face has grown too vertically. Having a positive result indicates that the face has not developed vertically enough. The higher the value, the more vertical insufficiency there is in the face.

The Jarabak ratio[12] utilises % of the front and back of the face. Calculate this ratio by using the formula below: Back of face height divided by 100. To estimate the anterior and posterior facial heights, measurements are taken from Nasion to Menton and Sella to Gonion, respectively. High angle instances have lower percentages than low angle cases, whereas a well-balanced face is between 62% and 66% of the total face surface area.

Each and every angle has its advantages and disadvantages to diagnosing the specific vertical discrepancy as the reference points, and reference planes used by various authors have their unique roles in determining the vertical relationships.[12]

These current measures for assessing vertical skeletal discrepancies have certain drawbacks. In an effort to address these issues, a clinically and statistically significant new metric for evaluating skeletal pattern in vertical direction has been developed.

In Tweeds analysis[8] Frankfort Horizontal Plane construction relies on a tangent to the lower border of the mandible for the Mandibular Plane, which is not the most trustworthy plane, hence FMA's dependability is a controversial practise.[13].

In Down's analysis[9] The Frankfort horizontal plane is used to create the angle of the Mandibular Plane. Porion and Orbitale are the two cephalometric points that make up this plane. Porion and Orbitale may be difficult to find. [13]. It is also used to determine how far forward, backward or downward the chin is in respect to the upper face in a Y-axis analysis. [13]. Consequently, both metrics are not particularly accurate in determining vertical skeletal patterns.In Steiner's analysis[10] S-N plane angle and the GoGn-SN angle may change if there is any structural abnormality. An anterior landmark on the symphysis, such as the gnathion, would be a better indicator of the chin's orientation. However, depending on the location of gnathion, the mandibular plane may shift, making this angle less dependable in the assessment of skeletal patterns.[13].

In the Facial axis angle[11], As a result, the Basion-Nasion plane is difficult to create and has a poor track record of success. Pterygomaxillare and Gnathion are also used in the angle, which may be more suited for measuring the chin's orientation than the skeletal patterns.[13].

The Jarabak ratio[12] The ratio between the anterior and posterior face heights might be evaluated using more than a vertical dysplasia indication.

This study is the first to examine how different skeletal analyses are related to each other and how they might be used to make accurate diagnoses and recommendations in the field of medicine. Furthermore, some instances show a broad range of values during cephalometric examination, and not all the measures employed to quantify vertical development suggest a unique pattern.

In 2013, Dr. Mohammed Rizwan and Dr. Rohan Mascarenhas[14] to overcome shortcomings of already existing parameters introduced 'R angle' for assessing skeletal discrepancies in vertical plane. They conducted the study on population of South Indian origin. The literature has showed that variation within the norms may occur due to ethnic differences. Hence, this study aimed to assess, evaluate and check reliability for vertical skeletal discrepancy by establishing a parameter 'R angle' in Navi Mumbai population.

MATERIALS AND METHOD

In this study, the lateral cephalometric radiographs of 135 orthodontic patients between the age group of 18-30 years of age were selected from the database of the Department of Orthodontics and Dentofacial Orthopaedics in D Y Patil University School of Dentistry, Navi Mumbai.

The subjects with only class I skeletal pattern, without any kind of facial or skeletal deformities in transverse and vertical plane were selected. The subjects who had never undergone any prior orthodontic treatment were considered in this study.

A minimum approximate of 44 subjects completing the study would be giving a good external validity to the present study.

❖ Method

- We used an 8x10 inch piece of acetate matte paper to trace all of the lateral cephalograms.
- All the lateral cephalograms were traced by only one examiner to eliminate any examiner bias at all
- This information was then utilised to develop and measure the parameters needed to identify any differences in the vertical structure of the skull. FMA, Y-axis, GoGn-SN angle, Facial axis angle, and Jarabak ratio are all included in this set of characteristics.
- Using the data obtained from the cephalogram, each sample was divided into three groups based on the FMA, GoGn-SN angle, Y axis, Facial axis angle, and the Jarabak ratio, where at least three out of five characteristics showed a certain skeletal pattern was present. These groupings were broken down into the following categories:

1. Low angle group (45 patients)
2. Average angle group (45 patients)
3. High angle group (45 patients)

- The R angle was measured for each subject in 3 groups and mean values were calculated. Also the reliability of R angle for assessing the vertical skeletal discrepancies was evaluated.

❖ Angular and Ratio Parameters

1) Frankfort mandibular plane angle (FMA)
2) Y axis
3) GoGn-SN angle
4) Facial axis angle
5) Jarabacks ratio
6) R angle

RESULTS

Table 1: Distribution of total 135 subjects in three groups as per the growth pattern.

	Frequency	Percent
average	45	33.3
high	45	33.3
low	45	33.3
Total	135	100

Table 2 : "Estimation of R angle for low, average and high angle cases.

						95% Confidence Interval for Mean					
	GP	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum	F value	p value of one way ANOVA"
FMA	L	45	21.36	5.318	0.793	19.76	22.95	11	39		
	A	45	27.93	3.271	0.488	26.95	28.92	21	39	59.779	.000**
	H	45	31.16	4.167	0.621	29.9	32.41	18	40		
JARABACK RATIO	L	45	70.84	4.147	0.618	69.59	72.08	65	86		
	A	45	65.18	3.163	0.472	64.23	66.13	58	75	67.345	.000**
	H	45	62.09	3.502	0.522	61.04	63.14	54	73		
GoGn-SN	L	45	23.989	4.6862	0.6986	22.581	25.397	10	31		
	A	45	31.422	4.2184	0.6288	30.155	32.69	22	45	100.217	.000**
	H	45	36.533	3.7209	0.5547	35.415	37.651	28	44		
Y axis	L	45	57.64	3.944	0.588	56.46	58.83	51	70		
	A	45	61.33	4.172	0.622	60.08	62.59	53	72	24.192	.000**
	H	45	63.96	4.81	0.717	62.51	65.4	53	76		
facial axis angle	L	45	92.07	2.31	0.344	91.37	92.76	86	98		
	A	45	90.13	2.492	0.371	89.38	90.88	85	94	14.663	.000**
	H	45	89.4	2.435	0.363	88.67	90.13	82	94		
R angle value	L	45	66.98	2.848	0.425	66.12	67.83	61	73		
	A	45	72.82	1.862	0.278	72.26	73.38	70	76	229.842	.000**
	H	45	78.22	2.645	0.394	77.43	79.02	75	87		

Table 3 : Inter group pair wise comparison with growth pattern using Post Hoc Test

	Cut off value	Growth pattern		
		average	low	Total
R	LT 70.5	3	43	46
	MT 70.5	42	2	44
	Total	45	45	90

Table 4 : "ROC to discriminate Low angle from Average angle cases

	Value	Df	P value
Chi-square	71.146[a]	1	0.000*

Table 5: ROC to discriminate Average angle from High angle cases.

	Cut off value	Growth pattern	

		average	high	Total
R	LT 75.5	42	6	48
	MT 75.5	3	39	42
	Total	45	45	90

	Value	Df	P value
Chi-square	57.857[a]	1	0.000*

Table 6: Values of Pearson's Co-efficient 'r' and its significance between R angle and other parameters.

		FMA	JARABACK RATIO	GoGn-SN	Y axis	facial axis angle	R angle
FMA	Pearson Correlation		-.616**	.664**	.615**	-.302**	.620**
	Sig. (2-tailed)		0	0	0	0	0
	N		135	135	135	135	135
JARABACK RATIO	Pearson Correlation	-.616**		-.869**	-.311**	.237**	-.645**
	Sig. (2-tailed)	0		0	0	0.006	0
	N	135		135	135	135	135
GoGn-SN	Pearson Correlation	.664**	-.869**		.473**	-.351**	.744**
	Sig. (2-tailed)	0	0		0	0	0
	N	135	135		135	135	135
Y axis	Pearson Correlation	.615**	-.311**	.473**		-.574**	.519**
	Sig. (2-tailed)	0	0	0		0	0
	N	135	135	135		135	135
facial axis angle	Pearson Correlation	-.302**	.237**	-.351**	-.574**		-.459**
	Sig. (2-tailed)	0	0.006	0	0		0
	N	135	135	135	135		135
R angle value	Pearson Correlation	.620**	-.645**	.744**	.519**	-.459**	

	Sig. (2-tailed)	0	0	0	0	0	
	N	135	135	135	135	135	

*- correlation is significant at the 0.05 level (2-tailed)
** - correlation is significant at the 0.01 level (2-tailed)

Table 7: Comparison of frequencies of R angle and FMA

		FMA			
		average	High	Low	Total
R	average	24	16	7	47
	high	11	28	3	42
	low	11	1	34	46
	Total	46	45	44	135

	Value	Df	P value
Chi-Square	70.508[a]	4	0

		Value	Asymp. Std. Error[a]	Approx. T[b]	P value
Measure of Agreement	Kappa	0.456	0.062	7.489	0

Table 8: Comparison of frequencies of R angle and Jarabak ratio

		JARABACK RATIO			
		average	High	Low	Total
R	average	20	9	18	47
	high	16	19	7	42
	low	2	0	44	46
	Total	38	28	69	135

	Value	Df	P value
Chi-Square	65.063[a]	4	0

		Value	Asymp. Std. Error[a]	Approx. T[b]	P value

Measure of Agreement	Kappa	0.419	0.059	7.111	0

Table 9: Comparison of frequencies of R angle and GoGn-SN angle

		GoGn-SN			
		Average	High	Low	Total
R	average	16	9	22	47
	high	8	30	4	42
	low	1	0	45	46
	Total	25	39	71	135

	Value	Df	P value
Chi-Square	86.908[a]	4	0

		Value	Asymp. Std. Error[a]	Approx. T[b]	P value
Measure of Agreement	Kappa	0.511	0.056	8.821	0

Table 10: Comparison of frequencies of R angle and Y axis

		Y axis			
		average	High	Low	Total
R	average	9	21	17	47
	high	8	27	7	42
	low	7	5	34	46
	Total	24	53	58	135

	Value	Df	P value
Chi-Square	34.274[a]	4	.000

		Value	Asymp. Std. Error[a]	Approx. T[b]	P value
Measure of Agreement	Kappa	.281	.060	4.788	.000

Table 11: Comparison of frequencies of R angle and Facial axis angle

		facial axis angle			
		average	High	low	Total
R	average	29	6	12	47
	high	15	24	3	42
	low	19	2	25	46
	Total	63	32	40	135

	Value	Df	P value
Chi-Square	50.015[a]	4	.000

		Value	Asymp. Std. Error[a]	Approx. T[b]	P value
Measure of Agreement	Kappa	.363	.065	6.047	.000

OBSERVATION:

- As shown in table 2, the mean value with standard deviation for low, average and high angle cases is 66.98 (2.848), 72.82 (1.862) and 78.22 (2.645) respectively. Depending upon the F value (229.842) and p value of one way ANOVA test (p<0.01), Statistically, there is a considerable difference in the development patterns of three groups.
- The table 3 depicts inter group pair wise comparison with growth pattern using Post Hoc Test. High and low angles were statistically significantly different from each other (p=0.01), as were average and high angles (p=0.01).
- To distinguish low angle from average angle scenarios, the receiver operator characteristic (ROC) curve is shown in table 4. Between the two groups, there was a statistically significant difference in frequency (p0.01). R angle > 70.5 had a sensitivity of 95.56 and specificity of 93.33% in distinguishing low angle situations from average angle cases, according to the ROC curves' results.
- It is possible to distinguish instances with an average angle from those with a high angle using the ROC curve shown in Table 5. The frequency differences between the two groups were statistically significant (p0.01). Deduced from the ROC curve, a R angle of 75.5 or above exhibited 92% sensitivity for distinguishing the average angle from high angle situations.
- For Navi Mumbai population, ROC curves reveal values below 70.5 indicate low angle instances; values between 70.5-75.5 indicate average angle cases; values over 75.5 indicate high angles.

Table 6 represents values of Pearson's Co-efficient 'r' and its significance between R angle and other parameters.

- According to this table, there is statistically significant, positive and moderate corelation (r: 0.620, p<0.01, 0.05) between R angle and FMA indicating that as the value of one variable increases, the other also increases.
- There is a statistically significant, negative and moderate corelation (r: -0.645, p<0.01, 0.05) between R angle and Jarabak ratio showing that as the value of one variable increases, the other decreases.
- It can also be seen that there is statistically significant, positive and high corelation (r: 0.744, p<0.01, 0.05) between R angle and SN-GoGn angle suggesting that as the value of one variable increases, the other also increases.

- It also shows that there is statistically significant, positive and moderate corelation (r: 0.519, p<0.01, 0.05) between R angle and Y-axis angle depicting that as the value of one variable increases, the other one also increases.
- On observation it was found that there is statistically significant, negative and moderate corelation (r: 0.459, p<0.01, 0.05) between R angle and facial axis angle depicting that as the value of one variable decreases, the other one increases.

Now to check for the reliability of R angle against the existing parameters, certain analysis were performed. Following were the observation of these analysis:

- An extremely significant difference (p0.01) was found in the frequencies between the groups (p0.01), with a greater frequency (70,508a) for agreements for each low, average, and high angle scenario when applying Chi-square test. Kappa analysis revealed statistically significant (p0.01) but only moderately high (0.456) agreement between the two parameters under study.
- There was a statistically significant difference (p0.01) in the frequencies of the R angle and the Jarabak ratio with a greater frequency (65.063a) for agreements for all three groups in the Chi-square test, which was observed. A substantial agreement (0.419) and a statistically significant (p 0.01) correlation between these two values was found using kappa analysis.
- All three groups' agreements occur at a greater frequency (86.908a) when compared using the Chi-square test, which shows that there is a statistically significant difference in frequencies between the R angle and the SN-G0Gn angle. Kappa analysis reveals statistically significant (p0.01) and modest degree of agreement between these two measures (0.511).
- When comparing the frequencies of R angle and Y-axis angle agreements in all three groups, the Chi-square test indicates a statistically significant difference (p0.01) with frequency (34.274a). It observed that there was fair measure of agreement (0.281) However, the kappa analysis result was statistically significant (p 0.01).
- The frequencies between R angle and Facial axis angle with An agreement is statistically significant (p=0.01) and more common in all three groups, according to a Chi-square test. Although kappa analysis suggested fair measure of agreement (0.363) Yet a very significant (p0.01) correlation was found between the two variables.

DISCUSSION

Facial equilibrium can only be achieved if the vertical growth pattern of the face is correct. [15] Orthodontic considerations might arise from differences in vertical development, which are prevalent. [16] In certain cases, an abnormally long or short face may be caused by abnormally hard or soft tissues that constitute the face. Gingival smiles, inadequate lips, and a lengthy face may all be the consequence of too much vertical growth. However, a lack of vertical development might result in a lack of incisor show, an overclosed lip, and a small face.[17] Both sorts of facial features are seen to be unattractive, hence they are listed on the list of orthodontic issues.[18] Orthognathic surgery is the most common treatment for these issues in adults, however functional jaw orthopaedics may be used in children as well.

Orthodontic treatment plans must take into account both where growth occurs and when it stops. A failure to manage the vertical growth component of growth may lead to complicated therapy, poor outcomes, and recurrence following treatment.[19] Such variations in the vertical face pattern need a comprehensive review and precise diagnostic evaluation if successful therapy is to be achieved.[20]

With the use of lateral cephalometry, diagnosing vertical skeletal issues has become easier and more precise than ever before. Downs[9] in 1948, In order to evaluate the mandibular diversion pattern, we employed the Frankfort horizontal (FH) plane as the reference line on lateral cephalograms, with Y axis and while utilising the FH plane. Tweed's[8] similar to that utilised in the Frankfort mandibular plane angle construction

(FMA). It was hypothesised by Steiner to use the anterior cranial base as the reference plane for measuring the angle between Sella-Nasion and the mandibular plane (SN-MP). Schwartz [21] there has been some discussion over the feasibility of measuring the intermaxillary relationship in the vertical dimension using the palatal plane (MMA). Later, linear metrics, such as the Jarabak ratio and the facial height ratio (LAFH:TAFH) were also utilised to analyse the vertical development of an individual's face. Also Tweed[8] After treatment, a vertical growth pattern has been linked to the stability of mandibular incisors.
In orthodontic diagnosis and treatment planning, correct vertical skeletal discrepancy measurement is essential. For a variety of reasons, researchers have come up with a number of alternative ways to measure skeletal discrepancies in various planes (transverse, vertical and sagittal). The Frankfort mandibular plane angle, GoGn-SN angle, Y-axis angle, Facial axis angle, and Jarabak ratio are the most often used criteria for assessing vertical skeletal mismatch. There are certain drawbacks of existing parameters.

1) Angles such as FMA and Y-axis are generated by employing Frankfort horizontal plane as one of their plane. By linking Porion and Orbitale, the Frankfort horizontal plane was established in 1884.

According to Krogman and Sassouni (1957), Ricketts (1961 and 1981) and Ricketts et al (1974); When generating the FH, using cephalometric instruments to define Porion might provide a large source of clinical error. 'Anatomic Porion' has been overlooked by several authors, including Broadbent [22](1931) have been using 'machine porion' instead. Radiographic marking on the ear rod is used to insert the cephalometric head positioning device into the external auditory meatus, creating this landmark. Ricketts (1981) Ear-rod location and external auditory meatus size are highly varied, which means that the machine Porion may be positioned far away from the real Porion.

2) Paranhos et al [23] (2014) found that in order to accurately measure vertical dysplasia in their study, they had to adjust their Y-axis to account for the varying location of Gnathion (Gn). Inadequacy of Y-axis was also observed in another study conducted by Schudy[4] in 1964
3) In Steiner's analysis[10], Gn-SN angle is produced by the SN (Sella-Nasion) plane, which connects the points Gonion and Gnathion, and the plane connecting them. (Gn). Sarhan [24] (Class I occlusions with acceptable profiles were selected for the study in 1989, The "craniofacial centroid line" was used as a mathematical reference system to measure the relative variations of the SN line for each participant. Three groups were formed from the sample. (71°-75°, 76°-80°, and 81°-86°) based on SNA value. In the lower SNA group, the SN line was discovered to rotate anticlockwise when compared to the centroid line of the skull, while in the higher SNA group, the SN line was found to rotate clockwise against the centroid line. It has been shown that the vertical orientation of the SN line modifies the features associated with points S and N, and hence may be misleading in data interpretation.
4) In McNamara analysis[11], the facial axis angle is formed by the intersection of the Basion-Nasion line and the Pterygomaxillary-Gnathion line. Basion and pterygo maxillary are less readily identified which makes the relative planes less reliable.
5) The Jarabak ratio[12] More often, the anterior-to-posterior ratio (APR) is employed to assess someone is face proportions.

In 2013, Dr. Mohammed Rizwan and Dr. Rohan Mascarenhas[14] To analyse vertical bone pattern in an anatomically correct manner based on an angle formed at the centre of condyle when C-N axis and C-M axis are intersected, the R angle is offered here. The C (centre of the condyle) is a prominent marker in the posterior face. Even though the condyle continues to expand, it is less influenced by growth and remodelling changes. It is a well-known landmark that is easy to find and dependable. In the study of Beta angle [25] in 2004 to assess sagittal skeletal pattern it has been effectively used. Nasion represents anterior-superior skeletal midline while Menton denotes the anterior-inferior skeletal midline landmark of face. Despite the above listed advantages of using this parameter, not many studies are available in literature pertaining to its reliability in assessing vertical skeletal discrepancies. There is evidence that the norms may be affected by ethnic variations. Therefore this study is conducted to check the reliability and establish the values of R angle for assessment of vertical skeletal discrepancies in Navi Mumbai population.

The 135 people in this research were categorised into low, medium, and high angle instances based on their FMA, GoGn-SN angle, Y axis angle, Facial Axis angle, and Jarabak ratio, respectively. In three of the five criteria, they show an unique skeletal pattern.

Each of the three angles has a mean and standard deviation of 66.98 (2,848 SD) with a standard deviation of 72.82 (1.862 SD). A one-way ANOVA test indicated that there was a statistically significant difference between the means of the three development patterns (p0,01), according to the results of the researchers. Both inter-group pairwise comparisons demonstrated a statistically significant R angle difference.

Low and high angle occurrences were distinguished by using the receiver operator characteristic (ROC) curve. According to the data, there was a statistically significant difference in the frequency of the two groups. R angle > 70.5 showed a sensitivity of 95.56 and specificity of 93.33% in distinguishing low angle instances from average angle cases. There were 92.86 percent specificity and 87.5 specificity for R angle > 75.5, which helped distinguish between normal and extreme instances of R angle > 75.5. As shown by ROC curves, in the Navi Mumbai population, values below 70.5 represent low angle cases, values between 70.5-75.5 indicate average angle cases, and values over 75.5 indicate high angle cases as a consequence.

To derive correlation between R angle and other parameters, Pearson's coefficient correlation was used. It was found that R angle and GoGn-SN angle has statistically significant, positive and high correlation, also indicating that if one value increases, The value of the other variable also rises. R angle and FMA and Y axis were statistically significant, positive, and moderately associated. R angle with Jarabak ratio and Facial axis angle showed statistically significant, negative and moderate correlation suggesting that as value of one variable increases the other decreases.

A study was conducted by Maheen Ahmed et al.[26] as a means of assessing the diagnostic efficiency of several cephalometric measurements for vertical growth in 2016. This study's multiple measures made use of the Y axis as well as SN-MP and MMA angles, as well as GoGn-SN and FMA, as well as R and Facial Height Ratio (LAFH:TAFH). R angle exhibits a modest association with the Y axis, FMA, and GoGn-SN angle, according to the results of this study.

The kappa and Chi square tests were used to determine the R angle's dependability in comparison to other metrics. As shown by the Chi-square test, there was a statistically significant difference between the groups with the greatest frequency of R angle agreement for each of low, medium, and high angle conditions. A statistically significant and modest measure of agreement between the two parameters was found using kappa analysis. The frequencies of R angle and Y axis has shown a statistically highly significant and fair measure of agreement with kappa analysis. A statistically significant, with high frequency was shown between frequencies for R angle and Facial axis angle. Also there was fair measure of agreement between both with kappa analysis.

The findings of this study are consistent with those of Dr. Mohammed Rizwan and Dr. Rohan Maccarenhas's research. [14] who evaluated the reliability of R angle in subjects of south Indian origin. The study found that the R angle is clinically and statistically important when examining vertical skeletal discrepancies.

So with the above results it is observed that R angle can be used to assess vertical skeletal discrepancy in Navi Mumbai population. Along with other parameters it can be important and valuable tool for orthodontist to determine skeletal discrepancies in vertical plane.

CONCLUSION:

The following findings have been derived from this research:

1. In order to provide an appropriate diagnosis and plan of therapy, the R angle is a useful tool for physicians.
2. In Navi Mumbai, R angles below 70.5 degrees represent low angle cases, those between 70.5-75.5 degrees are medium, and those beyond 75.5 degrees are high angle cases.
3. In the Navi Mumbai population, the R angle has proven to be a reliable tool for detecting vertical skeletal anomalies.
4. Other measures such as FMA, Y-axis, GoGn-SN angle, Facial axis angle, and Jarabak ratio for vertical skeletal discrepancies have showed substantial connection with R angle.
5. The R angle may be found on a digital lateral cephalogram using only a few cephalometric features.

No created points are used in the construction of the R angle, which helps to reduce operator mistake.

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