



ORIGINAL ARTICLE

Cephalometric evaluation of mandibular incisor inclination through incisor mandibular plane angle (IMPA): A cross-sectional study in Pakistan.

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ABSTRACT... Objective: To evaluate the incisor mandibular plane angle (IMPA) among the Pakistani population. **Study Design:** Cross-sectional Learning. **Period:** 1st January 2019 till 30th June 2019. **Setting:** Department of Orthodontics, University College of Dentistry The University Lahore. **Material & Methods:** 100 participants were incorporated in the learning by following inclusive standards. Demographic history i.e. name, age, gender, contact, and outcome variable i.e. IMPA value was recorded in a pre-designed proforma. Tracing of lateral cephalogram diagnosed as Class II Division I malocclusion was done by placing the Matte Acetate tracing paper over the radiograph. IMPA was used to assess the lower incisor inclination parameter Data were analyzed by using SPSS-20. Post-stratification students' t-test was smeared with p-value ≤ 0.05 as significant. **Results:** Out of 100 subjects, 44 subjects were males while the 56 subjects were females. The mean IMPA among all the patients were found to be $107.71^{\circ} \pm 3.89^{\circ}$. Whereas, the mean IMPA in male and female subjects was $106.91^{\circ} \pm 3.62^{\circ}$ and $108.34^{\circ} \pm 4.01^{\circ}$, respectively. Similarly, the mean IMPA in non-obese subjects was $107.81^{\circ} \pm 3.81^{\circ}$ and in obese subjects was $107.13^{\circ} \pm 4.41^{\circ}$, respectively. However, a non-significant relationship was found between both factors. **Conclusion:** The mean IMPA in patients with "Class II Division I malocclusion" is $107.71^{\circ} \pm 3.89^{\circ}$ with a minimum and maximum value of 100° and 117° which may be incorporated for the treatment plan among Pakistani population.

Key words: Cephalometric Analysis, Incisor Mandibular Plane Angle, IMPA.

INTRODUCTION

The position of the lower incisor is considered critical in orthodontics for establishing an appropriate diagnosis and devising a treatment plan. It even specifies whether extractions are required and what type of anchorage should be used. The inclination of mandibular incisors plays an essential role in determining dental aesthetics, occlusion, and stability. Excessive lingual inclination of mandibular incisors can lead to problems such as crowding, increased risk of traumatic dental injuries, and compromised aesthetics. On the other hand, if the mandibular incisors are excessively proclined (inclined towards the lips), it can result in a "buck-toothed" appearance, increased susceptibility to trauma, and difficulties with lip closure.

The incisal adaptation for different facial patterns has been referred to as the "Dentofacial Compensation" and it has been found that lower incisors are relatively proclined in Class II div 1 malocclusion.¹ These malocclusions can affect the gingival thickness, alveolar bone dimension overjet, and overbite. It impacts on growth modification in growing ages, extraction decision, anchorage requirements, stability, and retention concerns during camouflage therapy and pre-surgical orthodontic planning in adult surgical cases.²

The level of jaw correction achieved through growth modification is determined by pretreatment lower incisor inclination and overjet, which necessitates the use of pre-functional orthodontics. The anteroposterior alterations of lower incisors in

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Class II patients have been thoroughly reported while employing functional appliances such as Forsus, Herbst, and Jasper Jumper.³ In surgical instances, the first vs second premolar extraction followed by the requirement for reverse extraction is also reliant on the pretreatment lower incisor tilt and amount of overjet.⁴ Relapse and retention are also affected by the final lesser incisor penchant. Furthermore, the positioning of the lower incisors in the neutral zone is critical; otherwise, the aesthetics are damaged. Because of the importance of lower incisor inclination in “Class II div 1 malocclusions”, it is critical to analyse it.

Although the aesthetics, stability, and mean value of angle of the long axis of lower daggers and its relation to various cephalometric lines were analysed in order to meet the basic necessities of the treatment profile, no stable outcomes could be predicted using cephalometric reference lines.⁵ Steiner’s cephalometric analysis examined lower incisor inclination in relation to the Sella Nasion B point (NB) line (LI-NB 26°). The NB line, on the other hand, might be compromised by age, changes in Nasion Position in the sagittal and vertical planes, and inclination of the Sella Nasion (SN) plane. SN Plane inclination has long been questioned; nevertheless, Frankfurt Plane & Natural Head Position have superseded it in contemporary investigations LI-TH (120°15°).⁶

For the assessment of lower incisor inclination, the SN plane reference line LI-SN (548°) with the same constraints as indicated for Steiner’s Analysis was utilized. McNamara’s analysis and Ricketts analysis through LI-APog (22°4°) were used to analyse the lower incisor position; however, the Apo line is dependent on the maxillary position, position of point A, maxillary incisor inclination, and chin prominence.⁷ Tweed used FMIA (65°) to analyse the lower incisor inclination as part of the Tweed Triangle, which is fairly complete. The localisation of the Frankfurt plane is challenging because to portion overlap; nonetheless, the lower incisor mandibular plane (LI-MP) (90°5°) employed in Tweed’s study is the most often utilized in cephalometric measurements, despite being impacted by the vertical pattern.⁸ In Class II Division 1 malocclusion, reference lines

were associated. This evaluation may alter the entire treatment strategy, resulting in improved dentofacial aesthetics and so contributing to public health in general. The objected of this learning is to conclude the cephalometric inclination parameter IMPA used to measure lower incisor disposition in Class II div 1 malocclusion, so that the value may be incorporated into the treatment plan. Cephalometric radiograph created with CBCT.

MATERIAL & METHODS

This descriptive cross-sectional learning was conceded at the “Department of Orthodontics”, “University College of Dentistry The University Lahore” from Jan 2019 to June 2019. The study protocols were reviewed and approved by CPSP with reference no. CPSP/REU/DSG-2014-086-1422. The data was collected from 100 subjects presenting to the outpatient department with a confidence interval of 95%. Subjects with an age array of 12 to 30 years of either gender having all erupted teeth and ANB angle greater than 4° were included in the study. Moreover, it was made sure that all the subjects had Class II Division 1 Malocclusion. Any subject with a history of previous orthodontic treatment, an active diagnosis of pregnancy, transverse or vertical dysplasia were excepted from the learning. The learning protocols was permitted by the “Ethical Committee, University College of Dentistry”, The University Lahore, and informed agreement was attained from the selected patients ensuring the confidentiality of their diagnostic data.

All the subjects were clinically and radiographically by Tracing of lateral cephalogram diagnosed as Class II Division I malocclusion was done by placing the Matte Acetate tracing paper over the radiograph. IMPA was used to assess the lower incisor inclination parameter. Demographic history i.e. name, age, gender, contact, and outcome variable i.e. A pre-formatted preform was used to highest the IMPA value. The “Statistical Program for the Social Sciences” (SPSS-20) was used to examine the data. The information was shown in the form of a median and a standard deviation (SD). To explanation for these potential influence convertors, the data was separated by age,

gender, and BMI. We used a post-stratification students' t-test, defining success by a p-value 0.05.

RESULTS

Out of 100 subjects, 44 subjects were males while the 56 subjects were females. The mean age of all the cases was 21.68 ± 3.54 years with minimum and maximum age of 13 and 29 years. When stratified based on age 52 (52%) subjects were having an age of 12-21 years and 48 (48%) subjects were 22-30 years old. The mean weight, "height", and "BMI" were 67.13±11.30 kg, 1.66±0.14, and 24.59±4.99 correspondingly. (Table-I)

	Mean ± S.D.	Minimum Value – Maximum Value
Age (years)	21.68 ± 3.54	13.00 – 29.00
Weight (kg)	67.13 ± 11.30	47.00 – 90.00
Height (m)	1.66 ± 0.14	1.37 – 1.98
BMI (kg/m ²)	24.59 ± 4.99	15.33 – 37.44
IMPA (°)	107.71 ± 3.89	100.00 – 117.00

Table-I. Descriptive analysis of anthropometric measures and IMPA

According to BMI 85 (85%), subjects were non-obese and 15 (15%) subjects were obese. The mean IMPA among all the patients were 107.71° ± 3.89° with a smallest and extreme value of 100° and 117°. Whereas, the mean IMPA in the age collection of 12-21 years was 108.15° ± 3.54° and in the 22-30 years group the mean IMPA was 107.23° ± 4.21°. The mean IMPA in both age groups was statistically the same hence the statistically insignificant difference in Mean IMPA was found, p-value > 0.05.

Similarly, the mean IMPA in male and female subjects was 106.91° ± 3.62° and 108.34° ± 4.01° respectively. The mean IMPA in both genders was statistically non-significant with a p-value > 0.05. The mean IMPA in non-obese subjects was 107.81° ± 3.810 and in obese subjects was 107.13° ± 4.41 respectively. The mean IMPA in both obese and non-obese groups was statistically the same hence the statistically insignificant difference in Mean IMPA was found, p-value > 0.05. (as displayed in Table-II)

	Number of Subjects (Percentage)	IMPA (Mean ± S.D.)	P-Value*
Age groups			
12-21 years	52 (52.0)	108.15 ± 3.54	p=0.237
22-30 years	48 (48.0)	107.23 ± 4.21	
Gender			
Male	44 (44.0)	106.91 ± 3.62	p=0.068
Female	56 (56.0)	108.34 ± 4.01	
Body Mass Index (BMI)			
Obese	85 (85.0)	107.81 ± 3.81	p=0.536
Non-obese	15 (15.0)	107.13 ± 4.41	

Table-II. Categorical distribution of subjects and comparison of IMPA with age, gender, and BMI

*A t-test analysis between IMPA and age or gender or BMI was approved out to evaluate the association among the variables and IMPA.

DISCUSSION

The word "malocclusion" refers to all deviances of jaws and teeth from their usual arrangement. This involves a variety of issues such as differences in jaw and tooth size (spacing and crowding), problems with dental curves (vertical, transverse and sagittal), and individual teeth. The "Angle's classification" is one of the most basic and widely used methods for classifying malocclusions. This strategy allows dental professionals to quickly describe and communicate.⁹

The most commonly recurring malocclusion is Class II, however, it is hard to determine its prevalence, since the approaches used in its assessment and ethnic characteristic of the models are ineffective. It has been shown by studies that the occurrence of "Class II division 1 and division 2 malocclusions" ranging from 8.6% to 33.7% and from 0.6% to 6.7% correspondingly. There is a important alteration in the expression of occlusal features of class II malocclusions in different races. For example, the Class II molar comparative is significantly lesser in black children than the whites. In Brazil, an exact occlusal analysis showed that nearly 50% malocclusions in mixed dentitions and deciduous belong to Class II.¹⁰

There can be different occurrences in Class II malocclusions such as the "Anteroposterior Skeletal Discrepancy" amongst the mandible

and maxilla, moreover in the form of maxillary protrusion or the mandibular retrusion. There is a wide-ranging difference in the vertical facial pattern and these relations are superimposed on these patterns. These vertical facial patterns range between increased, decreased total, or normal, and lower frontal makeover heights.¹¹

The quantitative assessment of dento-alveolar process adjustment is a compensatory mechanism of sagittal malocclusion that adds data to the decision to pursue orthodontic treatment. Therefore, the only therapeutic options for skeletal imperfections are either counterbalancing the condition or orthognathic surgery in conjunction with orthodontic therapy. In the latter, the lower incisor's inclination is decompensated as a pre-surgical orthodontic therapy, making it less noticeable and hiding the underlying skeletal abnormality. This makes it much simpler to see positive outcomes after surgery. The lower incisor's natural tendency is corrected for much more in the solely orthodontist alternative, shifting it lingually in Class III and vestibular in Class II.¹²

Several studies have looked at the morphology of the lower piercing bone called the alveolar bone. Their findings suggest a close relationship in the incisor area, between labiolingual inclination of alveolar bone and labiolingual inclination of the incisor area. The association among tooth reclination and alveolar bone reclination is directly propotional, therefore the shaope of alveolar bone and inclination corresponds with each other in the incisor region.¹³

A study reported by Asensio-Sánchez V et al. (2008) shows the mean IMPA lower incisor inclination levels i.e. $90^{\circ} \pm 5^{\circ}$ 100 for mandibular in patients Class II Division I Malocclusion. However, in this study we found higher IMPA mean levels i.e. $107.71^{\circ} \pm 3.89^{\circ}$ with a minimum and maximum value of 100° and 117° .

In a current learning by Qamar CR et al. (2010), the cephalometric skeletal and dental features were assessed, regarding the sagittal and vertical dimensions of "class II division 1 and Class II division 2 malocclusions". 100 patients

were selected including male and females for obtaining lateral cephalograms to conclude the individualities of class II div 1 and class II div 2 malocclusions. In patients of class II/1, the lower teeth were proclaimed, while the class II/2 patients had normally inclined malocclusion.¹⁴ Another study by Bajracharya, the inclination parameter of subordinate incisor in Class II Division I malocclusion was evaluated which led to a conclusion that proclination is more pronounced in the low angle cases rather than average and high angle scenarios. However, these results do not reflect in our study.¹⁵

In a study by Gutermann et al. (2014) showed an insignificant relation linked to a significant correlation of lower incisor inclination concerning gender and age¹⁶, whereas the results obtained from this study exhibit a important association among these parameters. The inferior tooth position was evaluated in the Saudi population by Hassan, where it was found to be in normal site even in the Class II division. However, in the present study, the proclined lower incisors are evident in this disparity.¹⁷ A contrast in the study by Al-Khateeb and Al-Khateeb was found with the lower incisor inclination to be more proclined in Class II Division I malocclusion as reflected in our study.¹⁸

Various cephalometric evaluations were performed in a study by Aldress AM in 2010, where he analyzed upper and lower incisors to in comparison to different reference lines and points. Three groups were made and 102 lateral cephalometric radiographs were distributed among them according to their sagittal skeletal relationship. The statistical "analysis was performed by using analysis of variance" (ANOVA) and five methods were used to extent the inclination of upper and lower incisors. According to the results, there was a important change in the five methods used to compare the mandibular incisors. There was a strong correlation observed within angular measurements, while the L1-NA (mm) and L1-APog (mm) had a weak correlation. Besides, there are many other factors which influence the variations in measurements of incisors inclination. The results should be

interpreted carefully and clinicians should understand the weaknesses correctly as well. Further studies may be carried out to evaluate the Tweed analysis among Pakistani population.

CONCLUSION






According to the outcomes of the study, the mean IMPA cephalometric inclination parameter for mandibular incisors in patients with "Class II Division I malocclusion" is $107.71^\circ \pm 3.89^\circ$, with a minimum and maximum value of 100° and 117° that can be incorporated into the treatment plan. The study will provide recommendations for enhanced dentofacial aesthetics and public health in Pakistan.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	Vishal Dherwani	Data analysis, Data interpretation, Cephalometric.	
3	Talha Asad Khan	Study design, Questionnaire design, Literature search.	
4	Kashif Haroon	Results Analysis and Discussion.	
5	Hafiz Mahmood Azam	Proofreading, Drafting in literature search.	
6	M. Aqeel Aslam	Drafting discussion chapter, Data analysis, Drafting the manuscript.	