ISSN (O) : 2582-3271
PubMed-National Library of Medicine - ID: 101766917

International Journal of Dental Science and Clinical Research (IJDSCR)

Dr. Angel Vaidic Publication

Available Online at: http://www.ijdscr.org

Volume – 2, Issue – 5, September - October - 2020, Page No. : 67 - 74

The Reliability Of DW Plane In Determining Sagittal Disharmony

[1]Dr. Raghavan Rashmika, Post Graduate Student, Department of Orthodontics, Vishnu Dental College, Bhimavaram, West Godavari, Andhra Pradesh, India.

[2]Dr. V. Chakravarthy Goutham, Professor, Department of Orthodontics, Vishnu Dental College, Bhimavaram, West Godavari, Andhra Pradesh, India.

[3]Dr. C.V Priya Padma, Professor and Head of the Department of Orthodontics, Department of Orthodontics, Vishnu Dental College, Bhimavaram, West Godavari, Andhra Pradesh, India.

[4]Dr. D. Varma Praveen, Professor, Department of Orthodontics, Vishnu Dental College, Bhimavaram, West Godavari, Andhra Pradesh, India.

Citation Of This Article: Dr. Raghavan Rashmika, Dr. V. Chakravarthy Goutham, Dr. C.V Priya Padma, Dr. D. Varma Praveen, "The Reliability Of DW Plane In Determining Sagittal Disharmony", IJDSCR September - October - 2020, Vo2. – 2, Issue -5, P. No. 67-79.

Corresponding Author: : Dr. Raghavan Rashmika, Post Graduate Student, Department of Orthodontics, Vishnu Dental College, Bhimavaram, West Godavari, Andhra Pradesh, India.

Type of Publication: A Review Article

Conflicts of Interest: Nil

Abstract

Introduction

Determining proper antero-posterior jaw relationship is very important in orthodontic diagnosis and treatment planning. Wits appraisal, ANB angle and Nasion perpendicular are the most accepted measurements used to determine the jaw discrepancy. But each of these parameters has their own disadvantages. To overcome these disadvantages, the DW plane was introduced, which involved the Wing point and the Walkers point to determine the sagittal disharmony.

Aim

To evaluate the reliability of DW plane in assessing skeletal sagittal jaw discrepancy in skeletal class I individuals.

Materials and Methods

A total of 100 lateral cephalograms were obtained and were divided into 40 skeletal class I, 40 skeletal class II and 20 skeletal class III based on their ANB angle and WITS appraisal. For each patient the DW plane was estimated. The following measurements were taken; Perpendicular line to Nasion (WpN), Perpendicular line to Point A (WPA), Perpendicular line to Point B (WpB), Difference between (WpA-WpB). The mean and standard

deviation (SD) were calculated for all the parameters. Using test of significance difference of means, significant difference between the two-sample data (means of original study and means of present study) was found out.

Results

For skeletal class I, the mean values of WpN was 56.73 +/- 3.09mm, WpA was 46.55 +/- 6.5mm, WpB was 36.35 +/- 8.36mm and difference of WpA-WpB was 10.22+/- 3.2mm. The test of hypothesis difference of means was done to find significant difference in skeletal class I means between the data of the present study and the original study. The z value was 2.5 accepted with 1% level of significance, which indicates that there is no significant difference between the means of the present study and the original study. For skeletal class II, the mean values of WpN was 57.35 +/- 3.99mm, WpA was 45.05 +/- 9.88mm, WpB was 28.9 +/- 11.15mm and difference of WpA-WpB was 16.8 +/- 4.49mm. For skeletal class III, the mean values of WpN was were 56.1 +/- 2.8mm, WpA was 43.8 +/- 4.4mm, WpB was 42.5 +/- 4.75mm and difference of WpA-WpB was 1.35 +/- 5.58mm.

Conclusion

Variation in position of the Wing and Walkers point in individuals belonging to the same group of skeletal class I, class II or class III affected the reliability of the DW plane as a tool for assessing sagittal discrepancy. A wide range of values are obtained for skeletal class II and class III patients and most of the values are not clear to differentiate between skeletal class I, class II and class III using DW plane.

Keywords

Cephalogram, cephalometry, middle cranium, Walker's point, Wing point, Sagittal jaw discrepancy, DW plane.

Main Document

Introduction

Determining proper antero-posterior jaw relationship is very important in orthodontic diagnosis and treatment planning. Orthodontist relates the jaw bases to reference points in the cranial base of the skull to determine any discrepancies in the jaws. Various cephalometric parameters have been given in the past for subjects from different ethnic origins and ages. Wits appraisal, ANB angle and Nasion perpendicular are the most accepted measurements used to determine the jaw discrepancy.[7]But each of these parameters have their own disadvantages. The ANB angle, given by Cecil C. Steiner (1953)[1], is the most widely used measurement for determining the sagittal jaw discrepancies. But the ANB angle is affected by the rotations and variations in sagittal and vertical dimensions of the jaws relative to cranial base. This is because, the ANB angle is not affected by the length of the lines forming it. Hence it gives a wrong assumption of the jaw base discrepancy[2]. McNamara[3] in the 1984, eliminated the use of angular parameters and used linear measurements to determine antero-posterior jaw discrepancy. He used Nasion perpendicular to the Frankfort horizontal plane as a reference line. According to S. Eugene Coben[4] the growth of the synchondrosis translates the upper face in forward direction up to the age of 20 years, when the synchondrosis undergoes ossification. Hence the stability of the position of Nasion was doubted. In 1975, Jacobson[5] had devised a method called the Wits appraisal, where he eliminated the dependence on Nasion point. He suggested that projections of point A and point B over the occlusal plane could be used to determine the jaw discrepancies. But this method eliminated stable cranial landmarks. It was also difficult to coincide the right and left occlusal plane in conditions of dentofacial asymmetry, asymmetric location of external auditory meati or incorrect positioning of the head-holder. Changes were also observed in the occlusal

plane during orthodontic treatment[6]. Hatewar et al[7] in the year 2015 introduced a new cephalometric norm called the DW plane. This method uses landmarks called the Wing point and the Walkers point (Anterior Sella) which are present in the middle cranial fossa, to determine the sagittal discrepancy. The middle cranial fossa completes its development by 8years; much earlier than the anterior and posterior cranial fossa[8]. Also, the anterior wall of the Sella becomes stable by the age of 5 years, while at the posterior region of Sella, changes occur up to 16-18 years[9]. They had used DW plane to determine the cranial base length, maxillary length, mandibular length, jaw relations, rotation of the jaw bases along with height of the maxillary base in skeletal class I individuals. So, the aim of the present study is to check the reliability of the DW plane in skeletal class I individuals and to obtain norms for skeletal class II and class III cases; so that the DW plane could be used as a common tool for measurement of sagittal jaw relation.

Aim

This study was conducted to evaluate the reliability of DW plane in skeletal class I individuals.

Objectives

To evaluate reliability of DW plane in skeletal class I individuals in comparison with ANB angle and Wits appraisal.

To obtain norms for DW plane in skeletal class II and skeletal class III individuals.

Materials & Method

The study was conducted on 100 patients of West Godavari population. The lateral cephalograms were obtained from the pre-treatment records of patients who reported to the Department of Orthodontics and Dentofacial Orthopaedics, Vishnu Dental College, Bhimavaram.

The patients were included as per the following inclusion and exclusion criteria;

Inclusion Criteria

➢ Subjects after maturation stage (stage: 6) based on CVMI staging.

➢ Patients with a class I, class II or class III skeletal base based on ANB angle.

➢ Patients with a class I, class II or class III skeletal base based on Wits appraisal.

Exclusion Criteria

➢ History of previous orthodontic treatment or any orthographic surgery.

➢ History of trauma to the dentofacial region.

➢ Any craniofacial deformities relating to the cranio-facial region

Conventional pre-treatment lateral Cephalograms of the patients were obtained using cephalostat machine (Fig: 1). Patient's head position was standardized by placing the patient 5 feet from the x-ray source in Natural head position with maximum intercuspation and lips at rest. The obtained lateral cephalograms were manually traced onto 0.003-inch acetate paper with 0.5mm lead pencil using x-ray viewer. For each patient, the skeletal disharmony was estimated using the Steiner's ANB angle and Wits Appraisal (Fig: 2a, 2b).

Based on their skeletal relation the patients were divided into 3 groups.

➢ Skeletal class I (n=40)

➢ Skeletal class II (n=40)

➢ Skeletal class III (n=20)

Criteria for a patient to be included in Class I skeletal pattern:

1. Angle ANB of 0-4°
2. Wits appraisal of 0 to −1 mm.

Criteria for a patient to be included Class II group:

1. Angle ANB was above 4°
2. Wits appraisal greater than 0 mm.

Criteria for a patient to be included Class III group:

1. Angle ANB was lesser than 0°
2. Wits reading lesser than −1 mm.

For each patient the DW pane was estimated. A line was drawn joining the Walker's point (point W i.e. the mean intersection point of the lower contours of the anterior clinoid process and the contour of the anterior wall of the Sella) and the Wing point (point W i.e. the intersection of the contour of the ala major with the jugum sphenoidale) and a perpendicular was drawn to the above line passing through the point W as shown in Fig: 2c, 2d and Fig: 3.

Fig 1: Cephalostat

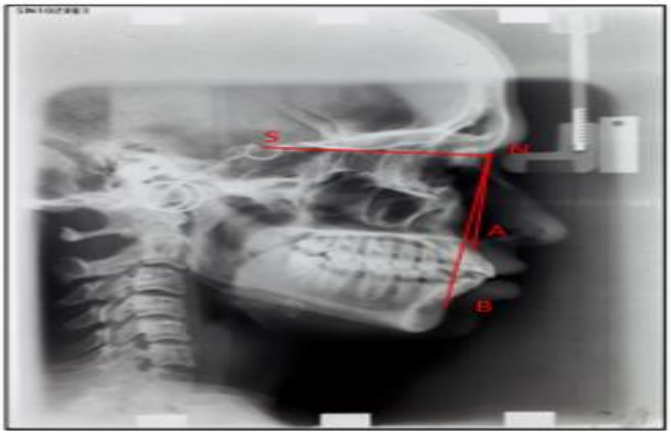

Fig 2a: ANB

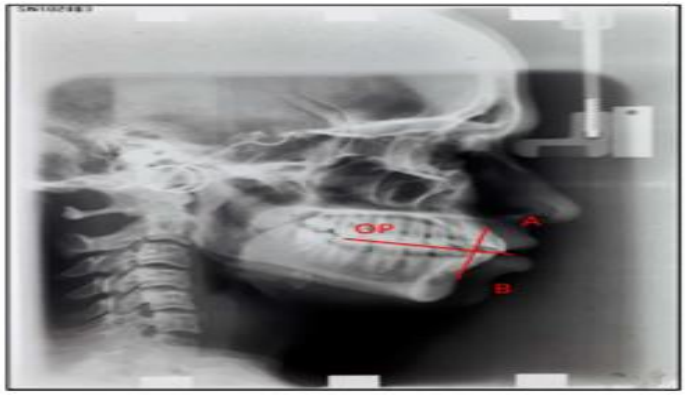

Fig 2b: Wits appraisal

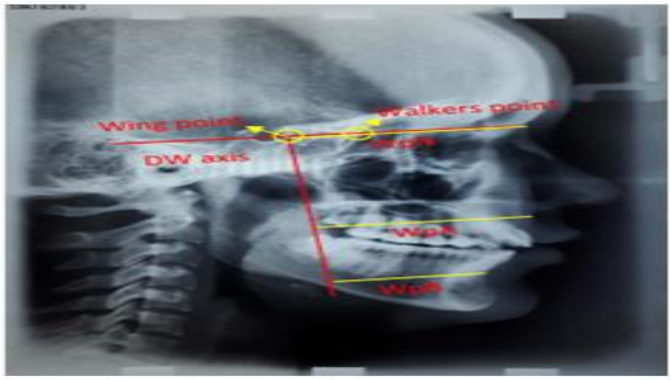

Fig 2c: DW plane of skeletal class I individual with normal WpB value

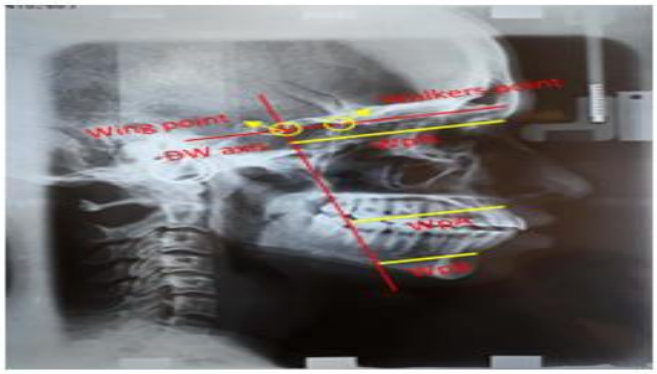

Fig 2d: DW plane of skeletal class I individual with decreased WpB value

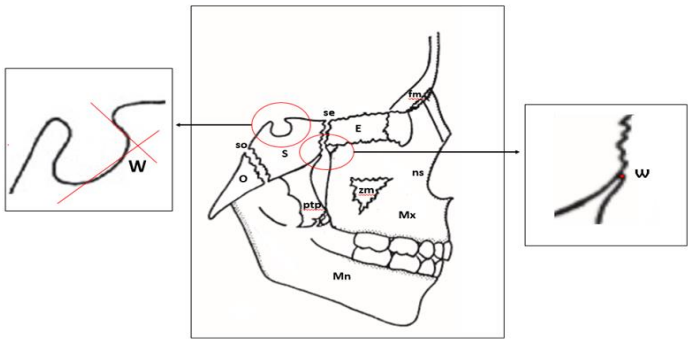

Fig3: E-Ethmoid bone, S-Sphenoid bone, O-Occipital bone, Mx-Maxilla, MnMandible, Fm-Fronto-maxillary suture, Se-Spheno-ethmoidal synchondrosis, So-Spheno-occipital synchondrosis, ptp- Pterygo-palatine suture, Zm-Zygomatico-maxillary suture, Ns- Nasal spine, W- Wing point, w- Walkers point.

The following measurements were taken;

- Perpendicular line to N (WpN): signifying cranial base length.
- Perpendicular line to A (WpA): signifying maxillary length.
- Perpendicular line to B (WpB): signifying mandibular length.
- Difference between (WpA-WpB): signifying skeletal jaw relationship.

The parameters used to derive the DW Plane analysis are enumerated in Table 1. All the tracings and analysis were performed by a single operator. The parameters derived were enumerated into a tabular form.

Table 1: Parameters for analysis

ANB (°) - Angle between two linear lines line AN and Line BN.
Wits appraisal (mm) – linear distance between AO and BO
WpN (mm) - Perpendicular line to N
WpA (mm) - Perpendicular line to A
WpB (mm) - Perpendicular line to B
WpA (mm)-WpB (mm) - Skeletal jaw relationship

Results

Skeletal Class I

For skeletal class I, the mean values of WpN was 56.73 +/- 3.09mm, WpA was 46.55 +/- 6.5mm, WpB was 36.35 +/- 8.36mm and difference of WpA-WpB was 10.22+/- 3.2mm (Table: 2). The test of hypothesis difference of means was done to find if there is any significant difference in skeletal class I means between the data of the present study and the original study of Hatewar et al[7]. The mean of WpA-WpB in the present study was 10.9+/- 3.2mm and in the original study was 8.2+/- 0.9mm. The z value was 2.5 accepted with 1% level of significance, which indicates that there is no significant difference between the means of the present study and the original study.

Skeletal Class II

For skeletal class II, the mean values of WpN was 57.35 +/- 3.99mm, WpA was 45.05 +/- 9.88mm, WpB was 28.9 +/- 11.15mm and difference of WpA-WpB was 16.8 +/- 4.49mm (Table: 2). In skeletal class II patients with maxillary prognathism the mean WpN was 57.9+/-5.5mm, WpA was 46.25+/-16.9mm, WpB was 33.6+/-14.7mm and difference of WpA-WpB was 15.6+/-4.6mm. In skeletal class II patients with mandibular retrognathism, the mean WpN was 56.8+/-3.1mm, WpA was 44.2+/-4.7mm, WpB was 24.3+/-11.3mm and difference of WpA-WpB was 16.8+/-4.6mm. In skeletal class II patients with maxillary prognathism and mandibular retrognathism mean WpN was 58.5+/-2.1mm, WpA was 46.5+/- 3.4mm, WpB was 33.5+/-7.7mm and difference of WpA-WpB was 16+/- 5.6mm.

Skeletal Class III

For skeletal class III, the mean values of WpN was were 56.1 +/- 2.8mm, WpA was 43.8 +/- 4.4mm, WpB was 42.5 +/- 4.75mm and difference of WpA-WpB was 1.35 +/- 5.58mm(Table:2). In skeletal class III patients with maxillary retrognathism, the mean WpN was 56.4+/- 2.1mm, WpA was 44.2+/-3.4mm, WpB was 39.8+/-7mm and difference of WpA-WpB was 6+/-4.3mm. In skeletal class III patients with mandibular prognathism the mean WpN was 55.7+/-2.6mm, WpA was 44.8+/-3.6mm, WpB was 40.9+/-9.2mm and the difference of WpA-WpB was 3.9+/-6.7mm. In skeletal class III patients with maxillary retrognathism and mandibular prognathism the mean

WpN was 58.5+/-1.2mm, WpA was 40.0+/- 6.5mm, WpB was 42.5+/-10.1mm and the difference of WpA-WpB was 2.5+/- 6.4mm. From the above result, it is observed that there is no specific range of values to distinguish skeletal class I, class II and class III.

Table 2*:* Mean and Standard deviation of WpN, WpA, WpB and WpA-WpB for skeletal class I, class II and class III cases (in mm).

	WpN (Mean/SD)	WpA (Mean/SD)	WpB (Mean/SD)	WpA-WpB (Mean/SD)
Skeletal class I	56.72+/-3mm	46.55+/-6.5mm	36.35+/-8.8mm	10.22+/-3.2mm
Skeletal class II	57.35+/-3.9mm	45.05+/-9.8mm	28.9+/-11.1mm	16.8+/-4.4mm
Skeletal class II	56.1+/-2.1mm	43.85+/-4.1mm	42.5+/7.7mm	1.35+/-5.5mm
P value	0.5	0.5	0.0*	0.0*

*****Statistically significant SD-Standard deviation

Discussion

Assessment of maxillo-mandibular sagittal discrepancy is of prime importance in diagnosis and treatment planning. There are numerous angular and linear measurements to assess the maxillo-mandibular sagittal discrepancy. Among all these measurements, ANB angle and Wits appraisal are commonly used. But these parameters have their short comings. Varied horizontal discrepancies in Point A and B could give the same ANB measurement because the variation in vertical distance from Nasion could compensate to other variations[10]. Instability of point N would also change the ANB measurement[11]. Wits appraisal by Jacobson[5] was also doubted as it was difficult to coincide the right and left occlusal plane in conditions of dentofacial asymmetry, asymmetric location of external auditory meati or incorrect positioning of the head-holder. Changes were also observed in the occlusal plane during orthodontic treatment[12].

To overcome the disadvantages of ANB and Wits, a new parameter called the DW plane was introduced, where stable points like the Wing point and the Walkers point are used to determine sagittal disharmony. The Walkers point is the mean intersection point of the lower contours of the anterior clinoid processes and the contour of the anterior wall of the Sella and the Wing point is the intersection of the contour of the ala major with the jugum sphenoidale. This Wing and Walkers point are present in the middle cranial fossa[2].

Unlike other sagittal analysis like the ANB in Steiner's analysis and Nasion perpendicular in McNamara Analysis, anterior cranial fossa was not considered because although the growth of the cranial base completes by the age of 6 years, the growth of the Speno-occipetal synchondrosis translates the anterior cranial base away from the foramen Magnum and the vertebral column (18-20yrs)9. Also, the morphology of the Sella turcica[13]does not change significantly after 12years of age and that at the age of 5 years the anterior wall of Sella becomes stable. Apposition is observed at the Tuberculum Sella and resorption at the posterior boundary of Sella turcica up to the age of 16-18 years[14].

Out of the 100 pre-treatment lateral cephalograms, 40 were taken with skeletal class I relation. Among the 40 patients, 6 were of male patients and 34 were female patients. The mean of WpN is 56.72+/- 3mm, WpA is 46.55+/-6.5mm, WpB is 36.35+/- 8.8mm and the difference of WpA-WpB is 10.22+/-3.2mm.

As the data of the original study was not available, Kappa statistics could not be performed. Hence means of the present study and original study were taken. Test of hypothesis difference of means was performed. As the z value was 2.5, it is proven that there is no significant difference present between the two sample data (one sample being that of the original study and the other sample being the present study), accepted with 1% level of significance. From this it can be concluded that DW plane

is a reliable tool to measure sagittal disharmony and therefore, could be an important criterion in determining a proper diagnosis and selecting reasonable treatment mechanics. In the present and original study, for a mean ANB of 2.4+/-1.3 and 1.8+/- 1.2 and mean WITS of 0.23+/-0.5mm and 1+/-0.8mm, the mean WpN was 56.6+/- 3mm and 69.4+/-4.2mm, WpA was 44.9+/-9.1mm and 62.1+/- 4.8mm, WpB was 34.9+/-10.2mm and 53.9+/-4.9mm and the difference of WpA-WpB was 10.9+/-4.6mm and 8.2+/-0.9mm . This increased difference in values between the original study and present study might be because of the difference in the selection of patients. In the original study patients with clinically balanced profile, normal overjet and overbite, cephalometrically normal ANB, WITS, Rakosi Jaraka's angle of inclination and mandibular plane were considered[2]. But in the present study, patients with ANB angle from 0-4 degrees and WITS of -1 to 0mm were considered in skeletal class I. Clinical norms, mandibular plane angle and Jarabak's analysis were not considered in the present study.

Among the 40 skeletal class II cases, 13 cases had maxillary excess, 24 cases had mandibular deficiency and 3 cases had combination of both. But, according to the DW plane, out of the 12 maxillary excess cases, only 1 case (7.6% of the cases) had true maxillary excess; among the 26 mandibular deficiency cases, only 7 cases(29% of cases) had true mandibular deficiency and among 2 cases with defect in maxilla and mandible, no case was seen with such a condition. There were 9 cases among the 40 skeletal class II cases, where the parameters coincided with skeletal Class I norms of DW plane.

Among the 20 skeletal class III cases, 5 cases had maxillary deficiency, 10 cases had mandibular excess and 5 cases had combination of both maxillary deficiency and mandibular excess. Among the 5 maxillary deficiency cases, no case had true maxillary deficiency; among the 11 mandibular excess cases, 2 cases had true mandibular excess and among the 4 cases with defect in both maxilla and mandible, no case satisfied the needed criteria. There were 5 skeletal class III cases with parameters coinciding with skeletal class I norms of DW plane.

From the above results, it is observed that there is a wide range of values included for skeletal class II and class III patients. Also, there is no specific range to distinguish between skeletal class I, class II and class III. For this reason, Analysis of variance (ANOVA) test as done to find significant differences in each parameter among Skeletal class I, class II and class III. It is seen that there is a statistically significant difference for WpB and WpA-WpB between Skeletal class I, class II and class III.

This variation in values of WpB might be due to the variation in position of the Wing and Walkers point in different individuals. In cases were the Walkers point is placed below the level of the wing point, the perpendicular to the DW plane will be more away from the Point B. In cases where the Walkers point is above the level of wing point, the perpendicular to the DW plane will be closer to the Point B.

Hence further studies should be done on DW plane in determining sagittal relation based on points which are stable as well as similar in all individuals. It should be kept in mind that variation in the stable cranial points among the individuals can change the diagnosis of the case.

Conclusion

Variation in position of the Wing and Walkers point in individuals belonging to the same group of skeletal relation affected the reliability of the DW plane as a tool for assessing sagittal discrepancy. A wide range of values are obtained for skeletal class II and class III patients and most of the values are not clear to differentiate between skeletal class I, class II and class III using DW plane.

References

1. Steiner CC. Cephalometric for you and me. American journal of orthodontics and dentofacial orthopedics. 1953 Oct1;39(10):729-55.
2. Taylor CM. Changes in the relationship of nasion, point A, and point B andthe effect upon ANB. American journal of orthodontics. 1969 Aug1;56(2):143-63.
3. McNamara Jr JA. A method of cephalometric evaluation. American journal of orthodontics. 1984 Dec1;86(6):449-69.
4. Coben SE. The spheno-occipital synchondrosis: the missing link between the profession's concept of craniofacial growth and orthodontic treatment. American journal of orthodontics and dentofacial orthopedics. 1998 Dec 1;114(6):709-12.
5. Jacobson A. The "Wits" appraisal of jaw disharmony. American journal of orthodontics. 1975 Feb1;67(2):125-38.
6. Jacobson A. Update on the Wits appraisal. The Angle Orthodontist. 1988 Jul;58(3):205-19.
7. Hatewar SK, Reddy GH, Singh JR, Jain M, Munje S, Khandelwal P. A new dimension to cephalometry: DW plane. Journal of Indian Orthodontic Society. 2015Dec;49(4):206-12.
8. Björk A, Skieller V. Normal and abnormal growth of the mandible. A synthesis of longitudinal cephalometric implant studies over a period of 25 years. The European Journal of Orthodontics. 1983 Feb 1;5(1):1-46.
9. Becktor JP, Einersen S, Kjær I. A sella turcica bridge in subjects with severe craniofacial deviations. The European Journal of Orthodontics. 2000 Feb 1;22(1):69-74.
10. Jacobson A, editor. Radiographic cephalometry: from basics to videoimaging. Quintessence Publishing (IL); 1995.
11. Enlow DH. A morphogenetic analysis of facial growth. American journal of orthodontics. 1966 Apr1;52(4):283-99.
12. Chang HP. Assessment of anteroposterior jaw relationship. American Journal of Orthodontics and Dentofacial Orthopedics. 1987 Aug1;92(2):117-22.