EVALUATION OF GLENOID FOSSA POSITION IN DIFFERENT MALOCCLUSION GROUPS IN NORTH INDIAN POPULATION- A CEPHALOMETRIC STUDY

Dissertation

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In

ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS

By

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(Faculty of Babu Banarasi Das University)

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I hereby declare that this dissertation entitled ***"EVALUATION OF GLENOID FOSSA POSITION IN DIFFERENT MALOCCLUSION GROUPS IN NORTH INDIAN POPULATION- A CEPHALOMETRIC STUDY"*** is a bonafide and genuine research work carried out by me under the guidance of ***Dr. KAMNA SRIVASTAVA***, Reader, Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

Date: 31-3-2022

Place: Lucknow

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INTRODUCTION

Orthodontic treatment aims to achieve a harmonious facial profile and occlusion in all three planes of space-vertical, sagittal and transverse. Mandibular condyle as well as glenoid fossa are important structures of TMJ that helps to sustain good occlusion and balanced stomatognathic system. The morphology of glenoid fossa and its relation to condyle influences sagittal, vertical and transverse position of jaws, which eventually contribute to development of various malocclusion. Also the morphology and position of glenoid fossa and its relation to condyle plays an important role in the long-term stability of treatment outcomes in patients undergoing Prosthodontic, Orthodontic or Orthognathic treatment. Several factors like facial growth pattern, pathologic, functional alterations, decreased or increased muscular action, occlusal force and dental occlusion changes could affect TMJ morphology and pattern. As a result of these changes there is remodelling of articulating surfaces of condyle and glenoid fossa as an adaptation response. Many studies showed condyle and glenoid fossa differ in shape among patients with different malocclusions[1,2]. Thus it is assumed that the mandibular position relative to the cranium is highly dependent upon the location of the glenoid fossa, which could be anteriorly or posteriorly located. This highlights the need to consider position of glenoid fossa by Orthodontist during diagnosis and treatment planning.

Anteroposterior positioning of maxilla and mandible decides the type of skeletal malocclusion. There is no jaws discrepancy in skeletal Class I malocclusion where is there could be either retrognathic or prognathic maxilla or both in skeletal Class II malocclusion and vice versa in skeletal Class III malocclusion. Anteroposterior positioning of mandible in different skeletal types (skeletal Class I, Class II and Class III malocclusions), can result in alteration in position of condyle with

corresponding adaptive change in glenoid fossa, hence it was decided to evaluate glenoid fossa position in these type of skeletal malocclusion in sagittal plane in present study.

There are many studies in which position of glenoid fossa has been evaluated using lateral cephalogram and CBCT. It was generally found in previous studies that glenoid fossa was more posteriorly located in skeletal Class II malocclusion than class I or class III malocclusion[1,2,3,4]. Few other studies suggested that in vertical plane, subjects of Class I normal occlusion, Class II malocclusions did not show significant difference in position of glenoid fossa[2,5]. Subjects with high mandibular plane angle had short ramus height and superiorly placed glenoid fossa whereas subjects with low mandibular plane angle had increased ramus height and inferiorly placed glenoid fossa. According to Baccetti et al[1], in vertical plane, the position of the glenoid fossa relative to basicranial structures was more caudal in low angle subjects when compared with subjects with normal or high angle vertical relationships.

Other studies evaluated condyle position relation to glenoid fossa in different malocclusion groups by Gelb's grid, and it was found in these studies that the anterior position of condyle(4,7 Gelb's position) to the glenoid fossa was seen mostly in subjects with Class I malocclusion and subjects with Class II malocclusion showed posterior position(5,8 Gelb's position)[6]. In another study, no variation was seen in condylar position in different malocclusion groups[7]. A study was conducted using template(grid) on CBCT for scanning of subjects with different malocclusions and found that 80% of the subjects exhibited superior-anterior position of the condyle[8]. Other studies evaluated glenoid fossa position in

different malocclusion by measurements of horizontal and vertical position of glenoid fossa with respect to sella, and found that in sagittal plane subjects with Class II malocclusion had increased sella to glenoid fossa distance than in subjects with Class I malocclusion. In vertical plane there was no significant difference in vertical position of glenoid fossa between the groups[2].

As variations are seen in different population groups with respect to prevalence of type of malocclusion, it was expected that condylar and glenoid fossa position might also vary between subjects of different racial or ethnic origin. A study discussed variations in condyle and glenoid fossa morphology within the same ethnicity and between ethnicity and found that, there was no significant difference for condylar dimension and glenoid fossa roof thickness between Malays and Chinese except when comparing the condylar height[9]. The trend for glenoid fossa positing was same in studies conducted in different population groups like of Pakistan[10], Srinagar[2], Malaysia and China[9] etc, but glenoid fossa measurements differed in these studies. As variations are anticipated in measurement of glenoid fossa position, it was decided to evaluate the same in our population in present study using lateral cephalogram which are routinely taken for all patients undergoing fixed orthodontic treatment. Though CBCT a three dimensional view would have been a better choice but CBCT is not routinely taken, is expensive and there is unnecessary expose to high amount of radiation. There are different ways to assess glenoid fossa and condyle position, like by Gelb's grid, assessment with respect to stable landmarks or measurement of joints places in a different planes of space. Glenoid fossa position had been assessed dropping horizontal and vertical lines from 'Sella' in most of the studies as it is a stable landmark and do not change

with growth and had been used for superimposition as well. Similar method was followed in the present study.

Despite the recognized role of the glenoid fossa in the etiology of malocclusions, as well as during Orthodontic treatment, literature has limited data to explain diagnostic significance of position of glenoid fossa with respect to jaw bases in different malocclusion groups. Hence in this study we decided to evaluate the glenoid fossa position with respect to maxilla and mandibular jaw bases in subjects of North Indian population, using lateral Cephalogram.

Aim & Objectives

AIM: To evaluate glenoid fossa position in different malocclusion groups in subjects of North Indian population.

OBJECTIVES:

1. To evaluate the glenoid fossa position with respect to maxillary and mandibular jaw bases in Class I malocclusion in subjects of North Indian population.
2. To evaluate the glenoid fossa position with respect to maxillary and mandibular jaw bases in Class II malocclusion in subjects of North Indian population.
3. To evaluate the glenoid fossa position with respect to maxillary and mandibular jaw bases in Class III malocclusion in subjects of North Indian population.
4. To compare the glenoid fossa position with respect to maxillary and mandibular jaw bases in Class I, Class II, Class III malocclusion groups.

Review of Literature

Droel R, Isaacson RJ (1972)[5] evaluated the morphologic relationship of the condyle and fossa in patients with different malocclusions and skeletal relationships. study was carried out on 160 subjects divided in to three groups respectively. Both of these studies found significantly smaller horizontal distance between glenoid fossa summit and point on supper point of anterior wall of sella turcica in class II malocclusion in comparesion to class III. Glenoid fossa position was more posterior in skeletal Class II when compared with skeletal Class III. In the vertical plane, the position of the glenoid fossa relative to basicranial structures was more caudal in low angle subjects when compared with subjects with normal or high angle vertical relationships. According to the authors vertical level of the glenoid fossa relative to point PNS appears to be an important element in the diagnostic assessment of vertical skeletal relationship. In high angle subjects glenoid fossa was placed more cranially in relation to the position of the posterior extremity of the palate.

Jeff TC, Ghosh J, Sinha PK, Nanda RS,Currier GF(1996)[11] evaluated the morphologic relationship of the condyle and fossa in patients with different malocclusions and skeletal relationships. Study was conducted on 232 subjects(age 9 years 4 months to 42 years 6 months). Result showed nonconcentricity and mild asymmetry of the condyle-fossa relationship were commonly observed. The left condyle was found to be more anteriorly positioned than the right, with the mean percentage of joint space being 6.93% on the left side and −1.24% on the right. Skeletal and dental Class III patients demonstrated significantly more anteriorly positioned condyles ($P<0.05$). There were no significant differences in condylar position between Class I and Class II groups based on ANB or Angle's classification. Further, no significant difference in condylar position was observed between groups based on overbite or crossbite.

Bacceti T, Antonino A, Frenchi L, Tonti M, Tollaro I(1997)[1] analysed the position of the glenoid fossa in subjects with different sagittal and vertical skeletal features. Study was carried out on 180 subjects (90 males and 90 females, aged 7–12 years) and divided in to three groups (60 subjects each) according to skeletal sagittal relationships and three groups (60 subjects each) according to skeletal vertical relationships. Cephalometric analysis comprised both sagittal and vertical measurements for the assessment of the position of the glenoid fossa in relation to surrounding skeletal structures. Result showed sagittal measurements, TMJ position was more posterior in skeletal Class II when compared with skeletal Class III. In the vertical plane, the position of the glenoid fossa relative to basicranial structures was more caudal in low angle subjects when compared with subjects with normal or high angle vertical relationships.

Katsavries EG(2003)[12] Studied the response of the glenoid fossa to mandibular protrusive appliances, apart from the condyle, much attention has been focused on what happens to the posterior wall of the fossa (post-glenoid process). Remarkably, the articular eminence was overlooked, although it is the most adaptive area of the temporomandibular joint. The purpose of this study was to explore the type of response of the articular eminence morphology to the use of mandibular propulsive appliances (activators). The was conducted on pre- and posttreatment lateral tomograms of 35 patients (18 boys and 17 girls) who had been diagnosed as suitable for treatment with a mandibular protrusive appliance (activator). And points located on each tomogram and linear measurements were used to evaluate any change in glenoid fossa morphology. Result showed that there is no statistically significant change in articular eminence morphology (height and inclination) as a result of using mandibular protrusive appliances.

Katsavrias EG, Voudouris JC (2004[13] determined the contribution of glenoid fossa modification in correction of skeletal Class II malocclusions. The lateral cephalograms of 30 patients age between 7.96 to 15.06 years. Who were given mandibular protrusive appliance (activator). The mean duration of treatment was 1.33 years. Tomograms were taken on a pre and posttreatment basis, and points were located on each tomograms and specific linear measurements were used to evaluate any changes in morphology of glenoid fossa. The result demonstrated that there was no significant radiographic contribution from glenoid fossa modifications for correction of skeletal Class II treated with mandibular protrusive appliance.

Serra MD, Gaviao MBD(2005)[6]: evaluated the condylar position through transcranial radiographs in children between 3 years and 6 years old and to associate it with morphological characteristics of primary dentition. The extraoral transcranial radiographs were taken . The condylar position was determined according to Gelb's template, in postural rest position (RP) and maximum intercuspal position (MI), and it was associated with the characteristics: normal occlusion (n ¼ 36), open bite with or without overjet greater than 3 mm (n ¼27), unilateral or bilateral posterior cross bite (n ¼14), overbite greater than 3 mm (n ¼ 15). The chi-square and the Fisher Exact Test were used to analyse the data. Result verified that when using Gelb's template, there was not a significant association between the occlusion type found and the position of the condyle in the glenoid fossa when considering the entire patient sample (P . 0.05). There was a great variability in positions, and most of the children had asymmetric condyles (55.43% in MI and 51.09% in RP). Children with normal occlusion and malocclusion presented the same proportions of condylar position in both mandibular positions.

Giuntini V, Toffol L De, Frenchi L, Baccetti T (2008)[14]: The position of the glenoid fossa was assessed in Class II cases associated with mandibular retrusion and normal mandible in the mixed dentition use lateral cephalogram. A sample of 30 subjects (16 male, 14 female) aged 9 years with skeletal and dental Class II malocclusion associated with mandibular retrusion, normal skeletal vertical relationships and normal mandibular dimensions, was compared with a matched group of 37 subjects (18 male, 19 female) with skeletal and dental Class I malocclusion. Class II malocclusion presented with a significantly more distal position of the glenoid fossa, when compared with the control group as measured by means of three parameters (GF-S on FH, GF-Ptm on FH and GF-FMN).

Innoceti C, Giuntini V, Defraia E, Baccetti T(2008)[15]: Investigated the position of the glenoid fossa in subjects with Class III malocclusion associated with mandibular protrusion to better clarify the role of this craniofacial component in Class III skeletal disharmony. A sample was taken with 30 subjects, aged 8 years 6 months, with skeletal and dental Class III malocclusion associated with mandibular protrusion, normal skeletal vertical relationships, and normal mandibular dimensions, was compared with a control group of 33 subjects with skeletal and dental Class I relationships. The comparisons between the Class III group and the control group on the cephalometric measures for the assessment of glenoid fossa position were performed. Result showed that Subjects with Class III malocclusion had a significantly more mesial position of the glenoid fossa, when compared with the control group as measured with 3 parameters.

Proff P, Will F, Bokan I, Fanghanel J, Gedrange T (2008)[16]: investigated the cranial base configuration in skeletal Class III patients to clarify the conflicting findings from literature. Initial lateral radiographs of 54 skeletal Class III patients and 54 matched controls (Class I,

II/1, II/2) aged 14 to 24 years were analyzed retrospectively for 21 cephalometric basicranial and jaw length relative to anterior cranial base length. In contrast to overall cranial base length, the anterior (N-S) and posterior (S-Ba, S-Ar) sections failed to show a significant reduction in class III patients. Resulting anterior condylar displacement was shown by significant reduction of Se-S-Cd and Ar-Ca. Relative mandibular length was significantly increased. Decreased basicranial angulation associated with Class III mandibular protrusion was clearly confirmed for skeletal Class III patients. Overall shortening of the cranial base apparently resulted from various minar alterations. The basicranial-maxillary relationship in skeletal Class III remains unclear.

Azzawi AM. A.A, Ali FA (2010)[17]: verified the position of the glenoid fossa in subjects with different sagittal and vertical skeletal patterns, to assess the correlation between the position of glenoid fossa and skeletal patterns. A lateral cephalometric study was carried out on 124 subjects aged 18-30 years, classified into skeletal sagittal relationships using ANB angle into three groups. The results revealed that in sagittal skeletal relation, the glenoid fossa position was more posterior in skeletal Class II when compared with skeletal Class III, while in the vertical plane; the position of the glenoid fossa relative to Basicranial structures was more caudal in low angle subjects when compared with subjects with normal or high angle vertical relationships.

Wigal TG, Dischinger T,Razmus T, Gunel E, Ngan P(2011)[18]: Determine the condyle/glenoid fossa changes of Class II patients treated with the edgewise crowned Herbst appliance in the early mixed dentition period and the stability of treatment after phase II fixed appliance therapy. Twenty two patients, with a mean age of 8.4 (1.0) years and Class II division 1 malocclusion treated consecutively with the edgewise crowned Herbst appliance in the early mixed dentition period, was included in the study. Lateral cephalograms was taken before Herbst treatment, immediately following Herbst treatment, and at the completion of phase II fixed appliance therapy. Results was compared with a control group of untreated Class II participants selected from the Bolton-Brush Study, who were matched for age, sex,

and craniofacial morphology. Twenty two cephalometric variables were evaluated. Net changes due to treatment (treated minus control) were obtained by subtracting changes due to growth provided by the data from the matched control group. Found that Overcorrection with the Herbst appliance resulted in a mean net reduction in overjet of 7.0 mm and a change in molar relationship of 6.4 mm. Significant differences was found for the anterior movement of the condyle and anterior aspect of the glenoid fossa compared with the controls. At the completion of the fixed appliance therapy, the net change in overjet and molar relationship was reduced to 3.0 and 2.2 mm, respectively. Most of the remaining corrections were caused by restraint in the maxillary growth. No significant differences were found in the position of the condyle and remodeling of the glenoid fossa compared with the controls. Forward positioning of the condyle and fossa was maintained at the end of phase II fixed appliance therapy.

Koshab M, Nambiar P, John J(2015)[9]evaluated an symptomatic temporomandibular joint for potential degenerative changes prior to surgical and Orthodontic treatment. The recently developed cone beam computed tomography(CBCT) allow measurement of TMJ bony structure with high accuracy. study was undertaken to determine the morphology, and its variations, of the mandibular condyle and glenoid fossa among malay and Chinese Malaysians. CBCT was used to assessed 200 joints in 1000 subjects with mean age,30.5 years. And measured size, positin of each codyle sample and the thickness of the roof of the glenoid fossa(RGF). No significant gender differences were noted in thickness of the RGF condylar length, however condylar volume, width height and joint spaces were significantly greater among males. with regards to comparison of both TMJs, the mean of the condylar volume, width and length of right TMJ were significantly higher, while the means of the left condylar height and thickness of RGF were higher. When comparing the condylar measurements and the thickness of RGF between the two ethnic, they found no significant difference for all measurements with exception of condylar height, which is higher among Chinese.

Nagaraj K, Jatti R, Durgekar SG (2016)[2] analysed the variation in the shape of the glenoid fossa in different mandibular configurations. A sample of 45 subjects aged 12 - 18 years were divided into three groups based on the ANB angle and also based on the mandibular plane angle. A study group with Class I and II malocclusion div1 and 2 showed statistically insignificant difference in sella to glenoid fossa distance (vertical) whereas, Class II malocclusions showed increased horizontal sella to glenoid fossa distance than the Class I study group . Low angle subjects showed increased vertical sella fossa distance and ramus height than high angle subjects. Subjects with steep articular eminence inclination had acute gonial angles and subjects tending towards flat articular eminence had obtuse gonial angles with proper mechanics, Class II cases could be corrected by anterior displacement of the glenoid fossa, high angle cases by an inferior displacement and the reverse for low angle cases**.**

Mengi A, Sharma VP, Tandon P, Agarwal A, Singh A (2016)[3] assessed the effect of glenoid fossa position location in various skeletal malocclusions on craniofacial morphology. Cephalometric data of 84 subjects were analyzed. Result showed significant association between glenoid fossa location and craniofacial morphology in skeletal Class I, Class II, and Class III malocclusion subjects by the regression analysis.

Kaur A, Natt AS, Mehra SK, Maheshwari K, Singh G, Kaur A(2016)[8] visualized and compare the position of condyle in the glenoid fossa for different occlusions by using CBCT. Cone beam computed tomographic images of 45 subjects, aged 18 to 42 years, were evaluated. Subjects were equally divided into three groups according to the A point, nasion, B point (ANB) angle. And found that In the sagittal plane, condyle is positioned nonconcentrically; positioned anteriosuperiorly in class I and III occlusions and lies posteriosuperiorly in class II occlusion. In the frontal plane, condyle is positioned centrally (mediolaterally) in all the three types of occlusions. In the axial plane, the parameters showed significant difference between the different occlusions.

No statistical significant distinction could be made in the position of the condyle when comparing the right and left joints.

Qadir M, Mushtaq M, Kalgotra S (2017)[4] evaluated a relation between glenoid fossa position and malocclusion in a sagittal direction on cephalograms of 90 subjects. Maxillary and mandibular position in a sagittal direction were assessed separately with glenoid fossa position. No significant difference was observed in glenoid fossa position in various malocclusion groups. Mandibular position vary significantly with a unit changed in glenoid fossa position when assessed separately.

Kapadia RM, Diyora SD, Shah RB, Modi BN(2017)[19] assessed Yen angle and W angle and compared them with ANB angle, Wits appraisal, and Beta angle in predicting sagittal jaw dysplasia. A total of 40 lateral cephalograms of class I malocclusion subjects were selected and traced as per the inclusion criteria. ANB angle, Wits appraisal, Beta angle, Yen angle, and W angle were measured and compared with each other. Results showed ANB angle, Wits appraisal, Beta angle, Yen angle, and W angle all show a significant correlation with each other. Yen angle and W angle show best correlation with ANB angle than W angle. Yen angle and W angle can be used to assessed sagittal jaw dysplasia in addition to the established angles.

Mattosa JM, Palomob JM, Ruellasc ACO, Cheibd PL, Eliliwie M, Soukif BQ(2017)[20] Tested the null hypotheses that the positions of the glenoid fossae and mandibular condyles are identical on the Class I and Class II sides of patients with Class II subdivision malocclusion. Retrospective three-dimensional (3D) assessments of the positions of the glenoid fossae and mandibular condyles were made in patients with Class II malocclusion. Relative to a fiducial reference at the anterior cranial base,

distances from the glenoid fossae and condyles were calculated in pretreatment cone beam computed tomographic scans of 82 patients: 41 with Class II and 41 with Class II subdivision malocclusions. The 3D distances from glenoid fossae to sella turcica in the X (right-left), Y (anterior-posterior), Z (inferior-superior) projections was calculated. And found that Patients with Class II malocclusion displayed a symmetric position of the glenoid fossae and condyles with no statistically significant differences between sides, whereas patients with Class II subdivision showed asymmetry in the distance between the glenoid fossae and anterior cranial base or sella turcica, with distally and laterally positioned glenoid fossae on the Class II side. Male patients had greater distances between glenoid fossae and anterior cranial fossae. The condylar position relative to the glenoid fossae did not differ between the two malocclusion groups nor between males and females**.**

Kantomaa T(2018)[21] investigated the correlation between the shape of glenoid fossa and the morphology of the mandible, ten measurements were made on 37 pretreatment cephalograms of orthodontic patients aged from 8.1 to 12.3 years. The inclination of the articulating surface of the glenoid fossa when measured in relation to the clival plane, nasion-sella line or the nasal plane, correlated strongly with the configuration of the mandible. The result showed further support the hypothesis that the shape of the glenoid fossa affects the growth of the mandible. A vertically oriented articulating surface of the glenoid fossa, seems to direct condylar growth more vertically than does an articulating surface, which is oriented more horizontally.

Verma P, Mahajan P, Faraz SA, Srikanth K, B. Ravichandra3, Bathla N(2020)[22] **e**valuated the condyle–fossa position and articular eminence angulation in dentate and edentate patients using a lateral cephalogram along a different axis. Cross-sectional study consisted of randomly selected 40 patients with 20 dentulous patients (Group I), and

age- matched 20 completely edentulous patients (Group II), within an age group 45–65 years. And evaluated twice for condyle- fossa position along X and Y axis and articular eminence angulation by an Oral & maxillofacial radiologist at an interval of two days. Result showed Significant difference in condyle - fossa distances along the X and Y axis in two study groups was suggestive of more upwards and forwardly placed condyles and more anteriorly placed glenoid fossae in Group II patients. Also, articular eminence angulation was noted more in edentulous patients but the difference was statistically insignificant.

Tabassum R, Amjad N, Malik F(2021)[10] compared of glenoid fossa position in subjects with class II skeletal malocclusion due to retrognathic mandible and class I skeletal malocclusion. Lateral cephalograms of 130 patients were selected according to inclusion criteria. And different angular and linear measurements were recorded. Cephalometric measurements were analyzed, and glenoid fossa position was compared in both groups. And found that Position of glenoid fossa in subjects with class II malocclusion is more distal and posterior as compared to the subjects with class I malocclusion. The effective parameters for the measurements of glenoid fossa are GF-S on FH, GF-Ptm on FH, and GF-FMN with p value 0.0001.

Vankadara S, Akula B, Nissi K.(2021)[23]analyzed the position of the condyle and joint spaces in the normal temporomandibular joint and to compare the efficacy of the Gelb 4/7 grid over dimensions of joint spaces to assess optimum condylar position using CBCT. CBCT images of 40 patients (right and left) without a history of TMJ disorders were selected. Anterior (Ajs), superior (Sjs), and posterior joint spaces (Pjs) on sagittal slices, medial (Mjs), and lateral (Ljs) on coronal view were measured and Gelb 4/7 grid on sagittal slices used to assess the condylar position. And found that the Significant difference between right and left sides in Ajs, Sjs, Mjs, and Ljs values. Significant differences were noticed in Mjs, Ajs values between males and females. Centric position is the most common position of the condyle, and 4/7 position is the most common according to Gelb 4/7 grid.

Nindra J, Sidhu M.S, Kochhar A.S, Dabas A, Valletta R, Rongo R, Spagnuolo G(2021)[24] compared the effects of treatment with Herbst appliance and fixed therapy with elastics on the condyle and glenoid fossa complex. Thirty patients aged between twelve and sixteen years with skeletal Class II malocclusion who met the inclusion criteria were included in the study. Fifteen patients treated with Herbst appliance (Group 1), and fifteen patients treated with Orthodontic camouflage using MBT prescription (MBTTM Versatile + Appliance System) (Group2). For Group 2, patients had CBCTs can taken before treatment either after Herbst appliance removal or at the end of treatment. CBCT scans were evaluated for changes in condyle-glenoid fossa complex. On inter-group comparison, the Herbst group showed statistically significant increases in the condylar height of 1.35 mm on the right and 1.21 mm on the left side, and a condylar volume of 111.03 mm3 on the right and 127.80 mm3 on the left side. The Herbst group showed anterior remodelling on the postero-superior aspect of glenoid fossa. Herbst appliance treatment induced growth at the condylar head and anterior remodelling of glenoid fossa, thereby improving the maxilla-mandibular relationship in growing skeletal Class II patients.

Oo LT, Miyamoto JJ, Takada JI, Moriyama K (2021)[25] investigated the morphological and functional effects on Mandibular asymmetry(MA), and evaluated the three-dimensional position of the glenoid fossa and its relationship to asymmetrical condylar translational movement. In this retrospective study, 50 subjects who previously underwent computed tomography for surgical purposes were divided into MA and control groups according to a mention deviation of at least 4 mm from the mid-sagittal plane. The glenoid fossae positions were evaluated using a three-dimensional analysis program. Condylar translational movements were recorded and measured by computerized axiography on protrusion. Side-to-side asymmetry was measured for each parameter. Asymmetry index value was calculated to assess the correlation between glenoid fossa position and condylar movement. Result showed In the MA group, glenoid fossa position on the shifted side was significantly inferior and posterior as compared to that on the non-shifted side and of the control group. Condylar path

length and sagittal condylar inclination were significantly greater on the shifted side versus non-shifted side, while no significant difference was found in transverse condylar inclination. The asymmetry index of the anterior–posterior glenoid fossa position was significantly correlated with that of condylar path length and bilateral transverse condylar inclination. In the control group, there were no significant correlations among the morphological and functional parameters.

Materials & Methods

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarsi Das College of Dental Sciences, Lucknow with an aim to evaluate Glenoid fossa position in different malocclusion groups in subjects of north Indian population**.** The records of 110 subjects with different malocclusion were screened (old and ongoing patients) from Department of Orthodontic and Dentofacial Orthopaedics , Babu Banarsi Das College of Dental Sciences for the present study. Final sample for this study consisted of 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups, group I (n=30, Class I skeletal malocclusion), group II (n=30, Class II skeletal malocclusion) and group III (n=30, Class III skeletal malocclusion) based on assessment of three parameters (ANB, WITS and YEN angle) for sagittal dysplasia on initial sample of 110 subjects.

SAMPLE

Criteria for sample selection:

Sample were selected on the basis of the following inclusion and exclusion criteria.

Inclusion criteria

1. Subjects whose two consecutive generations are of North Indian origin.
2. Subjects with age group of 18 to 28 years.
3. Pretreatment orthodontic cephalograms having full complement of permanent teeth up to 2nd molars.
4. Good quality lateral cephalograms with detectable contours of glenoid fossa.

Exclusion criteria

1. History of TMJ disorders or associated syndromes.

2. History of any TMJ injury or surgery.

3. History of having undergone Myofunctional, Orthopaedic, Orthodontic treatment.

ETHICAL COMMITTEE APPROVAL:

Prior to study, approval was taken from the ethical committee Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, U.P., INDIA. Informed consent was also taken from all the subjects as per the format.

Initial sample selection :

Pretreatment records of 110 subjects with different malocclusion were taken for screening from records of old and ongoing patients from Department of Orthodontic and Dentofacial Orthopaedics, Babu Banarsi Das College of Dental Sciences.

To confirm the sagittal dysplasia, values of following three parameter were measured for all the subjects.

1.ANB angle

2. YEN angle

3.WITS appraisal

The subjects who had borderline values or inconsistent result for any of these three parameters were excluded.

Final sample:

The final sample for this study was consisted of 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups, Group I (Class I skeletal malocclusion), Group II (Class II skeletal malocclusion) and Group III (Class III skeletal malocclusion) based on values of three parameters for sagittal dysplasia.

ARMAMENTARIUM FOR THE STUDY:

To conduct the present study armamentarium used are listed below.

1. **Cephalostat machine:** Planmeca proline XC cephalostat (Finland) machine were used to take digital lateral cephalograms of selected subjects (Figure 1).

Figure 1:Cephalostat machine.

2. **Hard copy of lateral cephalogram:** Pre-treatment Lateral cephalogram of subjects with Class I, II, and III malocclusion(Figure 2a, 2b and 2c).

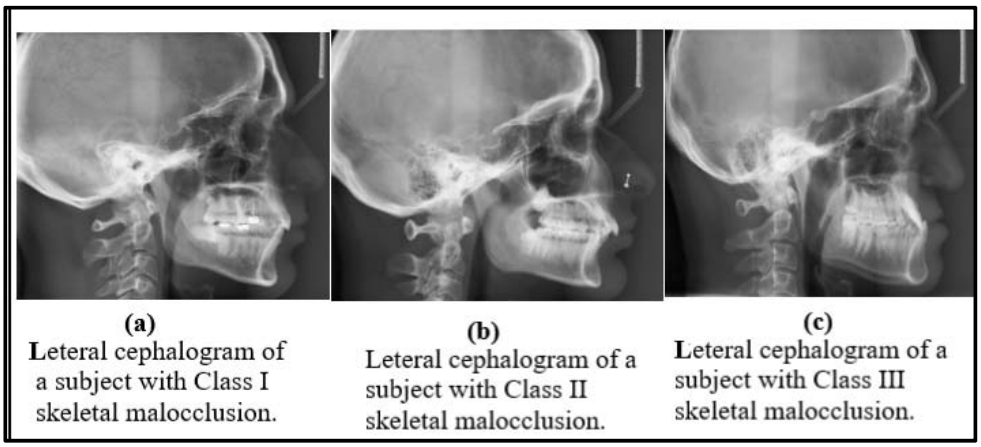
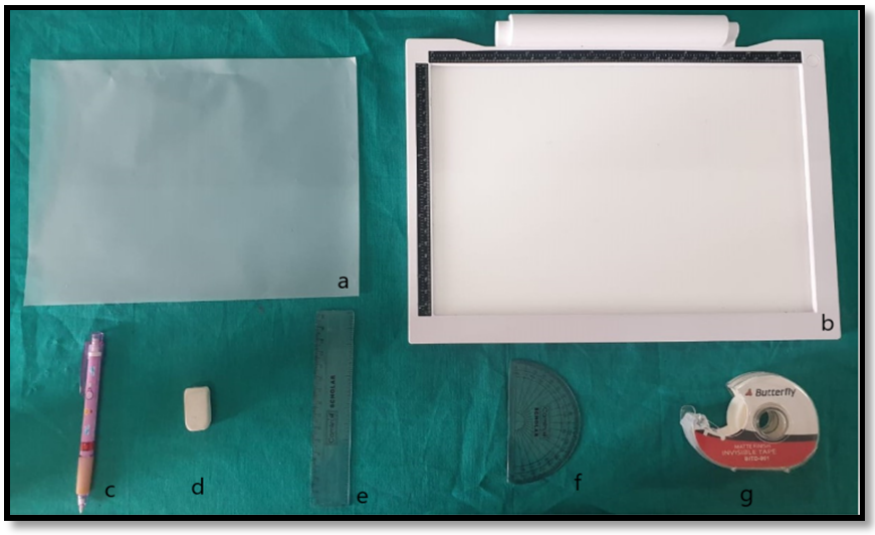


Figure 2: Lateral cephalogram of subjects with three types of sagittal malocclusion.

I. Armamentarium used for hand tracing and measurements of lateral cephalogram (Figure 3):

- Acetate paper 8x10inch,
- View box
- Adhesive Tape
- HB lead Pencil 0.5mm
- Eraser
- Scale
- Protractor



`Figure 3: Armamentarium use for hand tracing

a. Acetate paper ***d. Eraser*** ***f. Protractor***

b. Viewbox ***e. Scale*** ***g. Adhesive tape***

c. Lead pencil

METHODOLOGY:

1. **METHODS OF TAKING RADIOGRAPH (FIGURE 4)**:

Planmeca proline XC was used to take the digital lateral cephalogram of selected subjects. The lateral cephalograms were taken in natural head position with lips relaxed and teeth in centric occlusion. Natural head position is a standardized and reproducible orientation of head. The ear posts were used for correct alignment of the patients head for undistorted symmetrical image of the patient. Relaxed lip was achieved by giving direct instructions to the patient. The receptor-source distance was fixed at 60 inch. The exposure values were set at 68kV, 5mA at 23 second exposure time. All the cephalogram were transferred to a computer loaded with planmeca software

from where the hard copy lateral cephalograms were printed by AGFA Drystar printer.

Figure 4 : Patient position on cephalostat machine to take lateral cephalogram

2. METHOD OF HAND TRACING (FIGURE 5):

- Draw three orientation crosses on radiograph, two within cranium and one over the cervical vertebrae on the radiograph.
- Overlay the sheet of acetate tracing paper on the radiograph and attach the top edge with adhesive tape.
- Write the patient's name, age and date of radiograph above the crosses on the tracing paper.
- Trace the crosses onto the tracing paper for ease of subsequent superimpositioning of the tracing.
- Trace soft tissue and hard tissue outlines of various anatomic structures to complete hand tracing.

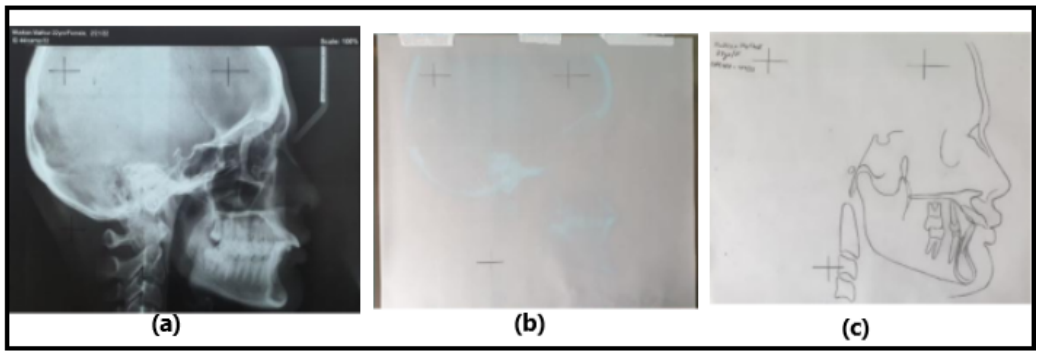


Figure 5: Method of hand tracing ,

(a.) lateral cephalogram with orientation crosses,

(b.) lateral cephalogram overlay by acetate tracing paper with orientation crosses,

(c.) complete tracing with soft tissue and hard tissue outlines of various anatomic structures.

3. Landmarks, planes and parameters used in the present study for selection of final sample:

Following landmarks were identified to measure the parameters for assessing saggital dysplasia ANB, WITS and YEN angle(Figure 6).

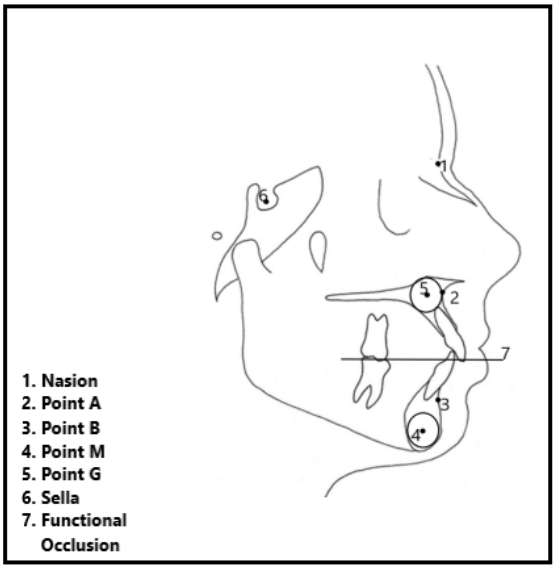


Figure 6: Landmark and reference planes used for final sample selection

A. LANDMARKS:

1. **N – Nasion.** Located on the most anterior aspect of frontonasal suture[25].
2. **Point A –** The most posterior point in concavity between ANS and maxillary alveolar process[25].
3. **Point B –** The most posterior point in concavity between the chin and mandibular alveolar process[25].
4. **S – Sella.** Geometric center of pituitary fossa located by visual inspection[25].
5. **Point M**(Geometric center of the premaxilla)- A circle is formed touching the maximum boundries of premaxilla and center of circle is consider as geometric center of maxilla(point M)[26].
6. **Point G** (Geometric center of the mandible)- A circle is formed touching the maximum boundries of anterior mandible and center of circle is consider as geometric center of mandible(point G)[26] .

B. REFERENCE PLANES:

1. **Functional occlusal plane -** A horizontal line formed by bisecting the intercuspation of the first premolars and the intercuspation of the first molar[25].

C. PARAMETERS USED FOR SELECTION OF FINAL SAMPLE: (FIGURE 7)

1. **ANB angle**: An angle formed between lines drawn from point A to Nasion (N) and fron nasion to point B[4] (figure 7a).
2. **WITS appraisal**: Formed by drawing perpendiculars from point A and point B on occlusal plane. The points of contact on functional occlusal plane from point A and point B are labelled AO and BO and distance between the two is measured[25] (figure 7b).

3. YEN angle: An angle between line drawn from sella (S) to point M and from point M to point G[26] (figure 7c)

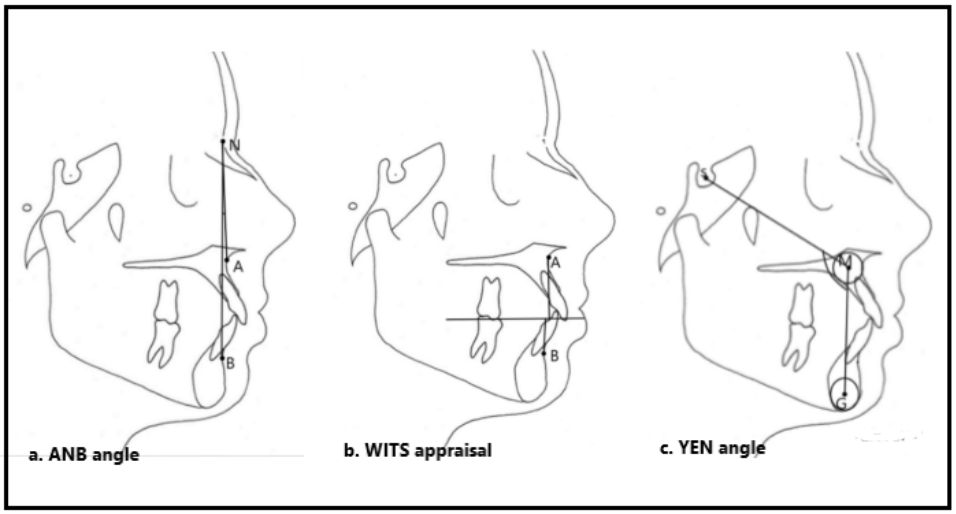


Figure 7: Parameters to confirm sagittal dysplasia.

(a) ANB angle,

(b) WITS appraisal and

(c) YEN angle.

The above measurements were made for all 110 subjects, the subjects who had borderline or inconsistent values were excluded from the study. Based on this, final sample size of 90 subjects were obtained, and divided in to three groups- Group I, Group II and Group III.

Table 1. Final distribution of the sample based on sagittal dysplasia.

GROUPS	ANB ANGLE		YEN ANGLE		WITS APPRAISAL	
N	**Normal values**	**Obtained mean Values from the sample**	**Normal values**	**Mean Values as obtain in study**	**Normal values**	**Mean Values as obtain in study**
Group I (Class I 30 malocclusion)	0-2^{o}	2.4^{o}+_0.9^{o}	117^{o} to 123^{o}	119.5^{o}+_5^{o}	0-1 mm	0.5+_0.5mm
Group I (Class II 30 malocclusion)	>2^{o}	5.5^{o}+_1.3^{o}	<117^{o}	111^{o}+_3.3^{o}	>1mm	3.46+_1.2mm
Group I (Class III 30 malocclusion)	<0^{o}	-3^{o}+_1.5^{o}	>123^{o}	132^{o}+_9.36^{o}	<0mm	-4.84+_2.8mm

4. ASSESSMENT OF GLENOID FOSSA POSITION :

Glenoid fossa position and various parameter with respect to glenoid fossa was measured for final sample of 90 subjects equally divided in three groups. Besides landmark and planes identified earlier, other landmarks used in the study are as follows:

1. LANDMARKS:

I. **Geometric center of glenoid Fossa (GF):** To locate the center of glenoid fossa method given by Brewka, Hatjigiogis[27] and Hongchen[28] was used. Following lines were drawn.(Figure 8)

a. Reference line: A reference line is drawn parallel to the Frankfort horizontal plane and tangent to the most superior aspect of the glenoid fossa(Line A).

b. Line B: A line is drawn parallel to the reference line and tangent to the crest of the articular eminence(Line B).

c. Line C: A parallal line is drawn midway between Line A and Line B.

d. Line D: A perpendicular line to line C is drawn Line D passing through the highest point of glenoid fossa.

e. The point of intersection of the Line C and Line D indicated the center of glenoid fossa.

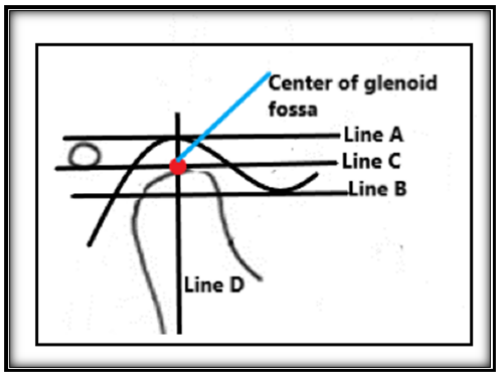


Figure 8: Center of glenoid fossa.

II. **Geometric Center of Condyle (C)** :To locate the geometric center of condyle various lines was drawn beside reference line used foe location of glenoid fossa[22].(Figure 9)

a. **Line1-** a line is drawn parallel to reference line and tangent to the hightest point of condyle.

b. **Line2-**A line drawn perpendicular to line1 and tangent to the most anterior aspect of the condyle.

c. **Line3-**A line is drawn parallel to line 2 and tangent to the most posterior aspect of the condyle.

d. **Line4-** a line is drawn parallel to line1, which is at a distance to line1 equal to that between line2 and line3.

e. The centre of condyle located on intersection of two diagonals of square formed by joining above 4 lines.

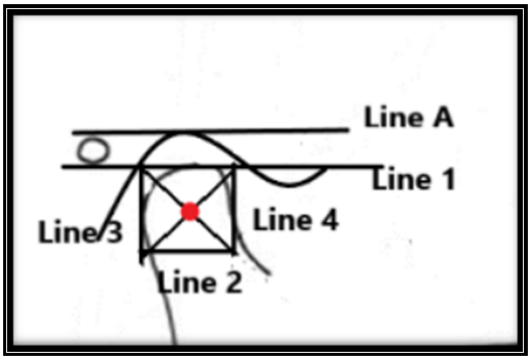


Figure 9: Center of condyle.

2. **ANTEROPOSTERIOR AND VERTICAL POSITION OF GLENOID FOSSA:**

Horizontal sella (S) to Glenoid fossa distance: A perpendicular line droped from sella on Line C named as point H. The horizontal distance between point GF to point H was measured to assess anterio-posterior position of glenoid fossa. (Figure 10).

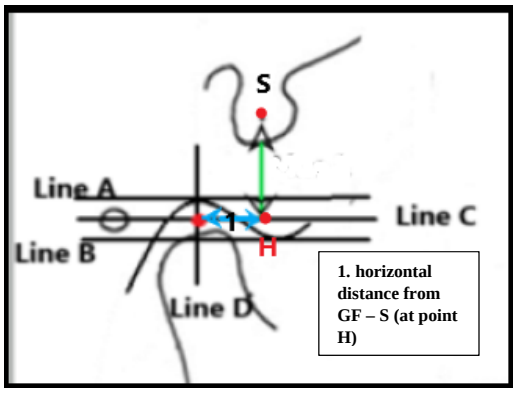


Figure 10: horizontal distance from glenoid fossa to point H.

I. **Vertical sella (S) to center of Glenoid fossa (GF) distance:** The perpendicular distance between sella and point H was measured to assess vertical position of glenoid fossa (Figure11).

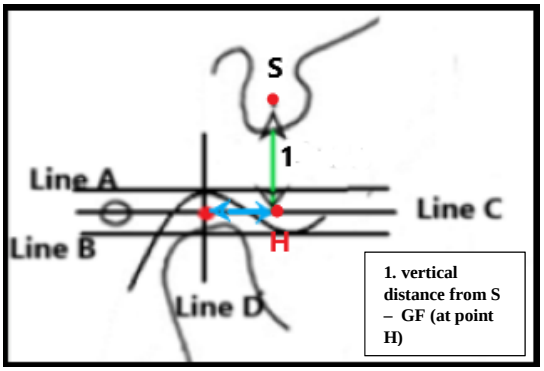


Figure 11: Vertical distance from glenoid fossa to Sella is point H.

3. PARAMETERS MEASURED WITH RESPECT TO GLENOID FOSAA AND CONDYLE-

1. **Mandibular length**: Distance between Centres of condyle (C) to Center of Mandible(G)[26](Figure 12).

2. **Maxillary length**: Distance from center of condyle (C) to point M[26] (figure 12).

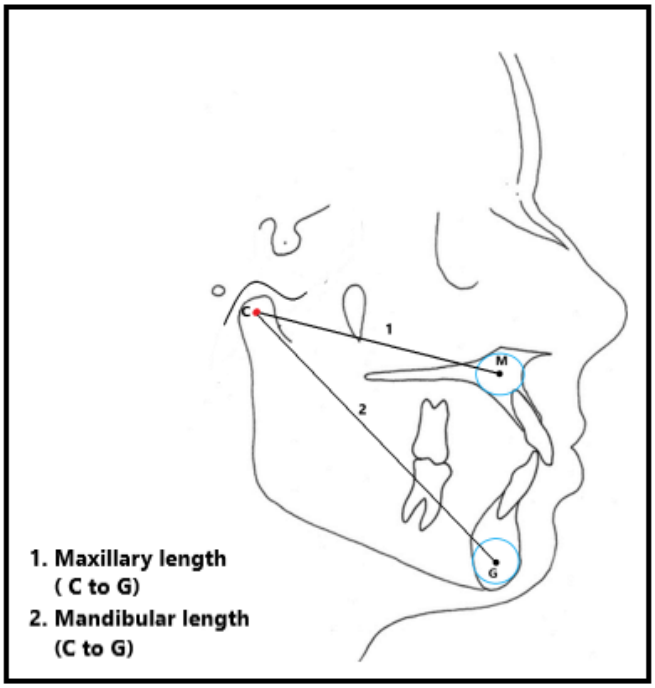


Figure 12: Maxilla and Mandibular length 1.maxillary length -C to M. 2. Mandibular Length- C to G .

4. POSITION OF MAXILLA AND MANDIBLE:

- A horizontal plane (HP) is formed at 7° from SN plane.
- The three perpendicular reference lines were drawn from HP passing through nasion, Ptm and center of glenoid fossa named as Line1, Line 2 and Line 3 respectively (figure 13).

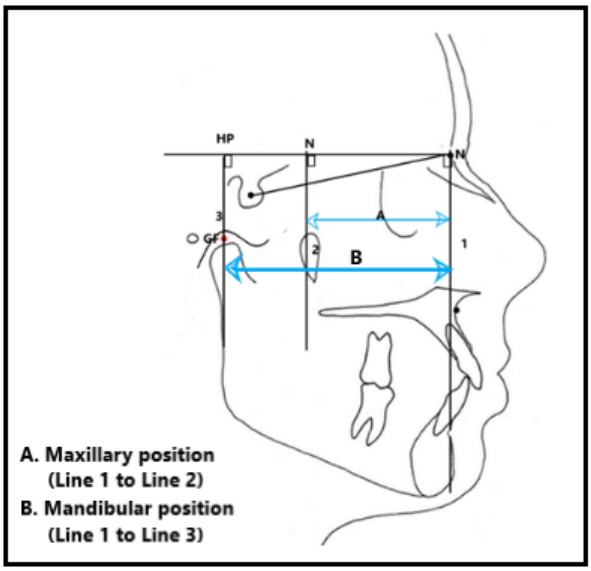


Figure 13 : Maxillary and Mandibular position.

A. maxillary position (from Line 1 to Line2)

B. mandibular position (from Line 1 to Line 3)

I. To assess the position of maxillary and mandible

- **a. Maxillary position**-Horizontal distance between Line1 and Line 2 was measured parallel to HP to assess position of maxilla.
- **b. Mandibular position**- Horizontal distance between Line1 and Line3 was measured parallel to HP to assess position of mandible.

5. ANGULAR PARAMETER

1. Angle GF-M-G: An angle between lines drawn from point GF to point M and from point M to point G. to evaluate relation between maxilla and mandible jaw bases (figure 14).

2. Angle GF-G_O-G: An angle between lines drawn from point GF to point gonion (Go) and from Go to point G to evaluate mandible rotation (figure.14).

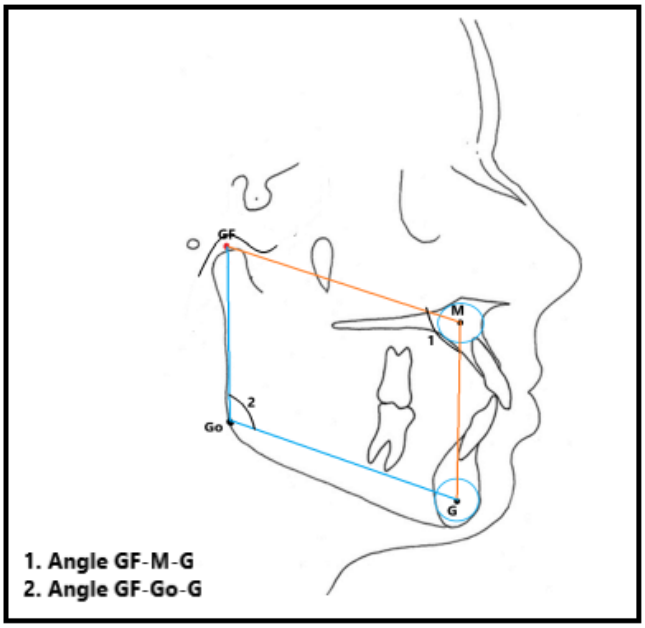


Figure 14: Angular parameters.

Statistical analysis: Data will be analyzed using Statistical Package for Social Sciences (SPSS) version 21, IBM Inc. Descriptive was reported for each variable. Descriptive statistics such as mean and standard deviation for continuous variables and frequency along with percentages of categorical variables were calculated.

Summarized data was presented using Tables and Graphs. Shapiro Wilk test was used to check which all variables were following normal distribution. As Data was found to be normally distributed (p-value was more than 0.05) bivariate analyses was performed using Independent t test and One way ANOVA test followed by post hoc tukey's test.. Level of statistical significance will be set at p-value less than 0.05.

TOOLS FOR STATISTICAL ANALYSIS

Formula used for the analysis

A. The Arithmetic Mean

The most widely used measure of central tendency is arithmetic mean, usually referred to simply as the mean, calculated as

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

B. The Standard Deviation

The standard deviation (SD) is the positive square root of the variance, and calculated as

$$SD = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}}$$

where, n= no. of observations

and also denoted by subtracting minimum value from maximum value as below

C. Tests of significance

Test of significance are used to estimate the probability that the relationship observed in the data occurred purely by chance was there a relationship between the variables. They are used to test the hypothesis proposed at the start of the study.

In this study Parametric tests were used

a) **The data was normally distributed**
b) **The data was obtained from the sample which is randomly selected**
c) **The data was quantitative data**

I. T TEST.

T tests are based on the t distribution which is a symmetrical, bell-shaped curve like the normal distribution, but having different area and probability properties.

T distribution is a family of curves which are differentiated by their degrees of freedom.

With increasing sample sizes, the t distribution assumes the shape of the normal distribution. 2 A sample size of 100 is often chosen as the cut-off point for deciding when to apply For t or z.

TYPES OF T TESTS INDICATIONS.

a) Paired T Test

The paired t test is used to decide whether the differences between variables measured on the same or similarly matched individual are on average zero. As the data are matched there must be an equal number of observations in each sample.

Assumption. The paired t-test assumes that the differences in scores between pairs are approximately normally distributed, although the two sets of data under scrutiny do not need to be normally distributed.

b) Unpaired or two-sample t test (equal variance assumed)

The unpaired t test is used for comparing two independent groups of observations when no suitable pairing of the observations is possible. The samples do not need to be of equal sizes.

Assumptions. The test requires the populations to be normally distributed with equal variance, though the test is relatively robust to deviations from these assumptions. Unpaired t test or two-sample t test (unequal variance)

When the variances of the two groups differ and transformation does not produce equal variance, the calculation of the t test becomes more complex. Instead of using the pooled variance, estimates of the individual population variances are used

Formula:

$$t = \frac{M_x - M_y}{\sqrt{\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}}}$$

M =mean

n = number of scores per group

$$S^2 = \frac{\sum (x - M)^2}{n - 1}$$

x = individual scores

M = mean

n= number of scores in group

- Define the problem
- State null hypthesis(H_0) & alternate hypothesis(H_1)
- Find t value, Find (X_1 - X_2)
- Calculate SE of difference between two means

$$SE = \sigma\sqrt{1/n_1 + 1/n_2} \text{ or}$$

$$t = (X_1 - X_2) / SE$$

- Calculate degree of freedom = $n_1 + n_2 - 2$
- Fix the level of significance (0.05)
- Compare calculated value with table value at corresponding degrees of freedom and significance level
- If observed t value is greater than theoritical t value, t is significant, reject null hypothesis and accept alternate hypothesis

II. ANALYSIS OF VARIANCE

Analysis of variance (ANOVA) is used when we compare more than two groups simultaneously. The purpose of one-way ANOVA is to find out whether data from

several groups have a common mean. That is, to determine whether the groups are actually different in the measured characteristic. One way ANOVA is a simple special case of the linear model. For more than two independent groups, simple parametric ANOVA is used when variables under consideration follows Continuous exercise group distribution and groups variances are homogeneous otherwise non parametric alternative Kruskal-Wallis (H) ANOVA by ranks is used. The one way ANOVA form of the model is

$Y_{ij} = \alpha_{.j} + \varepsilon_{ij}$

where:

- Y_{ij} is a matrix of observations in which each column represents a different group.
- $\alpha_{.j}$ is a matrix whose columns are the group means (the "dot j" notation means that α applies to all rows of the j^{th} column i.e. the value α_{ij} is the same for all i).
- ε_{ij} is a matrix of random disturbances.

The model posits that the columns of Y are a constant plus a random disturbance. We want to know if the constants are all the same.

Assumptions are:

a) Response variable must be normally distributed (or approximately normally distributed).
b) Samples are independent.
c) •Variances of populations are equal.
d) The sample is a simple random sample (SRS).

Two-way anova is used when we have one measurement variable and two nominal variables, and each value of one nominal variable is found in combination with each value of the other nominal variable. It tests three null hypotheses: that the means of the measurement variable are equal for different values of the first nominal variable; that the means are equal for different values of the second nominal variable; and that there is no interaction (the effects of one nominal variable don't depend on the value of the other nominal variable). When we have a quantitative continuous outcome and two categorical explanatory variables, we may consider two kinds of relationship

between two categorical variables, In this relationship we can distinguish effect of one factor from that of the other factor. This type of model is called a **main effect model** or **no interaction** model.

Tukey Multiple Comparison Test

After performing ANOVA, Tukey HSD (honestly significant difference) post hoc test is generally used to calculate differences between group means as

where,

$$q = \frac{\bar{X}_1 - \bar{X}_2}{SE}$$

$$SE = \sqrt{\frac{S^2}{2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

S^2 is the error mean square from the analysis of variance and n_1 and n_2 are number of data in group 1 and 2 respectively.

Statistical significance

Level of significance "p" is level of significance signifies as below:

$p > 0.05$	Not significant (ns)
$p < 0.05$	Just significant (*)
$p < 0.01$	Moderate significant (**)
$p < 0.001$	Highly significant (***)

Measurement reliability:

To check reliability of various measurements, prediction tracing was done for 10 subjects using same method. The readings of various soft tissue parameters were obtained and tabulated as second reading where as reading obtained originally were taken as first reading. Independent t test was used to obtain statistical significance between first reading and second reading of each parameter.

Table 2 : Measurement reliability

Parameters	Reading 1 Mean ± SD	Reading 2 Mean ± SD	'p' value
Horizontal fossa to sella distance (in mm)	10.8±2.3mm	10.2±2.4mm	0.357
Vertical sella to glenoid fossa distance (in mm)	18.6±1.5mm	18.3±1.9mm	0.722
Mandibular length (C-G) (in mm)	97.5±8.9mm	97.10±8.6mm	1.00
Maxillary length (C-M) (in mm)	73.3±3.9mm	73.3±1.2mm	1.00
Maxillary position (line 1 – line 2) (in mm)	49.4±3.5mm	49.4±3.6mm	1.00
Mandibular position (line 1- line 3) (in mm)	79.7±5.6mm	79.7±5.0mm	1.00
Angle GF-M-G (in degree)	106.5^{o}±3.6^{o}	106.5^{0}±3.5^{0}	1.00
Angle GF-Go-G (in degree)	113.5^{0}±3.2^{o}	113.7^{o}±3.5^{o}	1.00

NS = Non-significant (P>0.05); *=Significant (P<0.05); **Very significant

It was seen that mean difference between first and second reading of all eight parameters of ten subjects was statistically non significant, suggestive of reliability of measurements taken in the present study.

Observation And Results

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi Das College of Dental Sciences, Lucknow. The sample for this study consisted of 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups- Group I (n=30, Class I skeletal malocclusion), Group II (n=30, Class II skeletal malocclusion) and Group III (n=30, Class III skeletal malocclusion) in age range of 18-28 years (mean age 20.5 ±2.5SD years), with an aim to evaluate Glenoid fossa position in different malocclusion groups in subjects of north Indian population.

Glenoid fossa position was assessed in anteroposterior and vertical plane. Also various parameters in respect to glenoid fossa or center of condyle were measured to assess effective maxillary and mandibular length ,relation of jaw bases and mandibular rotation. Table 3 Shows overall intergroup comparison of all parameters used in the study.

Table 3. Descriptive statistics of all parameters used in the study

Parameters	Group	Mean +_SD (in mm)	Std. Error	95% Confidence Interval for Mean		Maximum	Minimum
Horizontal glenoid fossa to sella distance (GF-S) (in mm)	Class I	9.86 +_2.37	.4335	8.98	10.75	6.0	14.0
	Class II	10.36 +_1.97	.3603	9.63	11.10	7.0	14.0
	Class III	12.033+_3.51	.6423	10.72	13.34	6.0	19.0
Vertical sella to glenoid fossa distance (S-GF) (in mm)	Class I	19.16 +_4.25	.7777	17.57	20.75	12.0	25.0
	Class II	19.66 +_2.05	.3755	18.89	20.43	15.0	26.0
	Class III	20.867 +_2.54	.4642	19.91	21.81	14.0	26.0
Mandibular length (C- G) (in mm)	Class I	90.90 +_8.38	1.530	87.76	94.031	70.0	109.0
	Class II	89.33 +_ 5.92	1.082	87.12	91.546	73.0	102.0
	Class III	106.03 +_11.9	2.18	101.56	110.50	90.0	146.0
Maxillary length (C-M) (in mm)	Class I	74.20 +_6.94	1.26	71.60	76.79	64.0	91.0
	Class II	74.53 +_5.17	.94	72.60	76.46	67.0	91.0
	Class III	74.86 +_ 8.10	1.47	71.84	77.89	63.0	93.0
Maxillary position (Line 1 to Line 2) (in mm)	Class I	50.13 +_4.68	0.85	48.38	51.88	43.0	61.0
	Class II	49.83 +_ 2.65	0.48	48.84	50.82	45.0	56.0
	Class III	53.467+_4.40	0.85	51.71	55.20	43.0	65.0
Mandibular position (Line 1 to Line 3) (in mm)	Class I	77.20 +_4.85	0.88	75.38	79.01	70.0	84.0
	Class II	78.06+_4.71	0.86	76.30	79.82	70.0	89.0
	Class III	81.10 +_7.95	1.45	78.12	84.072	66,0	100.0
Angle GF-M-G (In degree)	Class I	111.70+_12.25	2.23	107.13	116.27	100	170
	Class II	110.70+_6.68	1.22	108.21	113.19	93	122
	Class III	120.33+_11.73	2.14	115.95	124.71	102	150
Angle GF-Go-G (In degree)	Class I	103.57+_5.30	.969	101.58	105.55	90	114
	Class II	98.63+_6.83	1.11	96.36	100.90	90	116
	Class III	111.30+_7.9	1.45	108.33	114.27	91	133

Table 4. Over all inter group comparison of all Parameters used in the study (using ANOVA).

Parameters	Groups	Mean ±SD	P value
Horizontal glenoid fossa to sella distance (GF-S at point H) (in mm)	Class I	9.86 ±2.37 mm	0.007***
	Class II	10.36 ±1.97 mm	
	Class III	12.033±3.51 mm	
Vertical sella to glenoid fossa distance (S-GF at point H) (in mm)	Class I	19.16 ±4.25 mm	0.098 (NS)
	Class II	19.66 ±2.05 mm	
	Class III	20.867 ±2.54 mm	
Mandibular length (C- G) (in mm)	Class I	90.90 ±8.38 mm	0.0001***
	Class II	89.33 ± 5.92 mm	
	Class III	106.03 ±11.9 mm	
Maxillary length (C-M) (in mm)	Class I	74.20 ±6.94 mm	0.931 (NS)
	Class II	74.53 ±5.17 mm	
	Class III	74.86 ± 8.10 mm	
Maxillary position (from Line 1 to Line 2) (in mm)	Class I	50.13 ±4.68 mm	0.005 (NS)
	Class II	49.83 ± 2.65 mm	
	Class III	69.233±86.20 mm	
Mandibular position (from Line 1 to Line 3) (in mm)	Class I	77.20 ±4.85 mm	0.036*
	Class II	78.06±4.71 mm	
	Class III	81.10 ±7.95 mm	
Angle GF-M-G (In degree)	Class I	111.70°±12.25°	0.0001***
	Class II	110.70°±6.68°	
	Class III	120.33°±11.73°	
Angle GF-Go-G (In degree)	Class I	103.57°±5.30°	0.0001***
	Class II	98.63°±6.83°	
	Class III	111.30°±7.9°	

NS= Non-significant(P>0.05); *=Significant (P<0.05); **=Very significant (p<0.01); ***=Highly significant (P<0.001)

Assessment of Anteroposterior (horizontal distance GF- S at point H) Position of glenoid fossa: The measurement for glenoid fossa position in anteroposterior plane(horizontal distance between GF (center of glenoid fossa to sella at point H) showed maximum mean value for group III (12.02+_3.5mm) followed by group II (10.36+_1.97mm) and lowest for group I (9.86+_2.3mm). Over all inter group comparison showed statistically significant difference between them (P=0.007).

Assessment of vertical Position of glenoid fossa: The measurement for vertical glenoid fossa position (vertical distance between sella at GF at point H) showed maximum mean value for group III (20.86+_4.25mm) followed by group II (19.66+_2mm) and lowest for group I(19.16+_4mm). Over all inter group comparison showed statistically non significant difference between them(P=0.098).

Mandibular length: The measurement for mandibular length showed maximum mean value for group III (106+_11mm) followed by group I (90.90+_8mm) and lowest for group II(89.333+_11mm). Over all inter group comparison showed statistically significant difference between them (P=0.0001).

Maxillary length: The measurement for maxillary length showed maximum mean value for group III (74.86+_8mm) followed by group II (74.5+_5mm) and lowest for group I(74.20+_6mm).) Over all inter group comparison showed statistically non significant difference between them (P=0.931).

Maxillary position (from Line 1 to Line2): The measurement for maxillary position showed maximum mean value for group III (53.4+_4.6mm) followed by group I (50.13+_4.6mm) and lowest for group II(49.83+_2mm).). Over all inter group comparison showed statistically significant difference between them (P=0.005).

Mandibular position (from Line 1 to Line 3): The measurement for mandibular position showed maximum mean value for group III (81.10+_7mm) followed by group II (78.06+_4mm) and lowest for group I (77.20+_4mm). Over all inter group comparison showed statistically significant difference between them (P=0.036).

Angle GF-G_O-G (to evaluate mandible rotation): The measurement for Angle GF-Go-G showed maximum mean value for group III (120.7+_11mm) followed by group I (111.70+_12mm) and lowest for group II (110.70+_6mm). Over all inter group comparison showed statistically significant difference between them (P=0.0001).

Angle GF-M-G (to evaluate relation between maxilla and mandible jaw bases): The measurement for angle GF-M-G showed maximum mean value for group III (111.3+_7mm) 2followed by group I (103.5+_5mm) and lowest for group II(98.6+_6mm). Over all inter group comparison showed statistically significant difference between them (P=0.0001).

Table 5: Individual intergroup comparison of all parameters used in the study (by Tukey's post Hoc comparison test).

Group	Horizontal glenoid fossa to sella distance (GF-S) (in mm)	Vertical sella to glenoid fossa distance (S-GF) (in mm)	Mandibular length (C- G) (in mm)	Maxillary length (C-M)(in mm)	Maxillary position (from Line 1 to Line 2) (in mm)	Mandibular position (from Line 1 to Line 3	Angle GF-M-G (In degree)	Angle GF-Go-G (In degree)
I vs II	0.752 (NS)	0.807 (NS)	0.783 (NS)	0.981 (NS)	0.957 (NS)	0.843(NS)	0.012**	0.928(NS)
I vs III	0.007***	0.091 (NS)	0.0001***	0.924 (NS)	0.007***	0.034**	0.0001***	0.006***
II vs III	0.050*	0.296 (NS)	0.0001***	0.981 (NS)	0.003***	0.131(NS)	0.0001***	0.002***

NS= Non-significant(P>0.05); *=Significant (P<0.05); **=Very significant (p<0.01); ***=Highly significant (P<0.001)

Assessment of Anteroposterior (horizontal distance GF- S at point H) Position of glenoid fossa: On individual comparison of groups it was found that, Group III had higher horizontal distance GF-S than Group II with mean difference (1.97+_1.54mm) and this was statically significant (P=0.05) . Group III had higher horizontal distance GF-S than Group I with mean difference (2.17+_1.14mm) and this was statistically significant (0.007). Group II had higher horizontal distance GF-S than Group I with mean difference (0.53+_.0.45) and this was statistically non significant (p- 0.752).

Assessment of vertical Position of glenoid fossa: On individual comparison between groups it was found that group III had higher vertical distance S-GF (at H point) than group II with mean difference(1.2+_0.49mm) and this was statistically non significant (P=0.296). Group III had higher vertical distance S-GF (at H point) than group I with mean difference (1.7+_1.71mm) and this was statistically non significant (P=0.091). Group II had higher vertical distance S-GF(at H point) than group I with mean difference (0.5+_2.20mm) and this was statistically non significant (p- 0.807).

Mandibular length: On individual comparison between groups it was found that group III had higher Mandibular length than II with mean difference(16.7+_5.98mm) and this was statistically significant (P=0.0001). group III had higher Mandibular length than I with mean difference (15.13+_3.52mm) and this was statistically significant(P=0.0001). Group I had higher Mandibular length than II with mean difference(1.57+_2.46mm) and this was statistically non significant (P=0.783).

Maxillary length: On individual comparison between groups it was found that group III had higher Maxillary length than II with mean difference(0.33+_2.93mm) and this was statistically non significant (P=0.924). group III had higher Maxillary length than I with mean difference(0.66+_1.16mm) and this was statistically non significant

(P=0.924). Group II had higher Maxillary length than I with mean difference (0.33+_1.77mm) and this was statistically non significant (P=0.981).

Maxillary position (from Line 1 to Line2): On individual comparison between groups it was found that group III had higher line 1 to Line 2 distance (maxillary position) than II with mean difference (0.33+_2.93) and this was statistically significant (P=0.003). Group III had higher line 1 to Line 2 distance (maxillary position) than I with mean difference(0.66+_1.16) and this was statistically significant (P=0.007). Group I had higher line 1 to Line 2 distance (maxillary position) than group II with mean difference (0.33+_1.77) and this was statistically non significant (P=0.957).

Mandibular position (from Line 1 to Line 3): On individual comparison between groups it was found that group III had higher line 1 to Line 3 distance (mandibular position) than II with mean difference (3.04+_3.24mm) and this was statistically non significant (P=0.131). Group III had higher line 1 to Line 3 distance (mandibular position) than I with mean difference (3.9+_3.1mm) and this was statistically non significant (P=0.034). Group II had higher line 1 to Line 3 distance (mandibular position) than group I with mean difference (0.86+_0.14mm) and this was statistically non significant (P=0.843).

Angle GF-M-G (to evaluate relation between maxilla and mandible jaw bases): On individual comparison between groups it was found that group III had higher angle GF-M-G than II with mean difference (9.63+_5.05mm) and this was statistically significant (P=0.0001). Group III had higher angle GF-M-G than I with mean difference (8.63+_0.5mm) and this was statistically significant (P=0.0001).

Group I had higher angle GF-M-G than group II with mean difference (1+_5.5mm) and this was statistically significant (P=0.012).

Angle GF-G_O-G (to evaluate mandible rotation): On individual comparison between groups it was found that group III had higher angle GF-Go-G than II with mean difference (12.67+_5.38mm) and this was statistically significant (P=0.0002). Group III had higher angle GF-G0-G than I with mean difference (7.73+_2.6mm) and this was statistically significant (P=0.0006). Group I had higher angle GF-Go-G than group II with mean difference (4.94+_1.5mm) and this was statistically non Significant (P=0.928).

Discussion

Mandibular condyle as well as glenoid fossa are important structures of TMJ that helps to sustain good occlusion and balanced stomatognathic system. The morphology of Glenoid fossa and its relation to condyle influences sagittal, vertical and transverse position of jaws, which eventually contribute to development of various malocclusion.

Many studies showed condyle and glenoid fossa differ in shape among patients with different malocclusions[1,2,3]. Thus it is assumed that the mandibular position relative to the cranium is highly dependent upon the location of the glenoid fossa, which could be anteriorly or posteriorly located. This highlights the need to consider position of glenoid fossa by orthodontist during diagnosis and treatment planning. Anteroposterior positioning of mandible in different skeletal types (skeletal Class I, II, III malocclusions), can result in alteration in position of condyle with corresponding adaptive change in glenoid fossa, hence it was decided to evaluate glenoid fossa position in these type of skeletal malocclusion in sagittal plane in present study. There are many studies in which position of glenoid fossa has been evaluated using lateral cephalogram and CBCT[8]. However lateral cephalogram taken routinely for subjects undergoing, fixed orthodontic treatment were used to assess glenoid fossa position in present study.

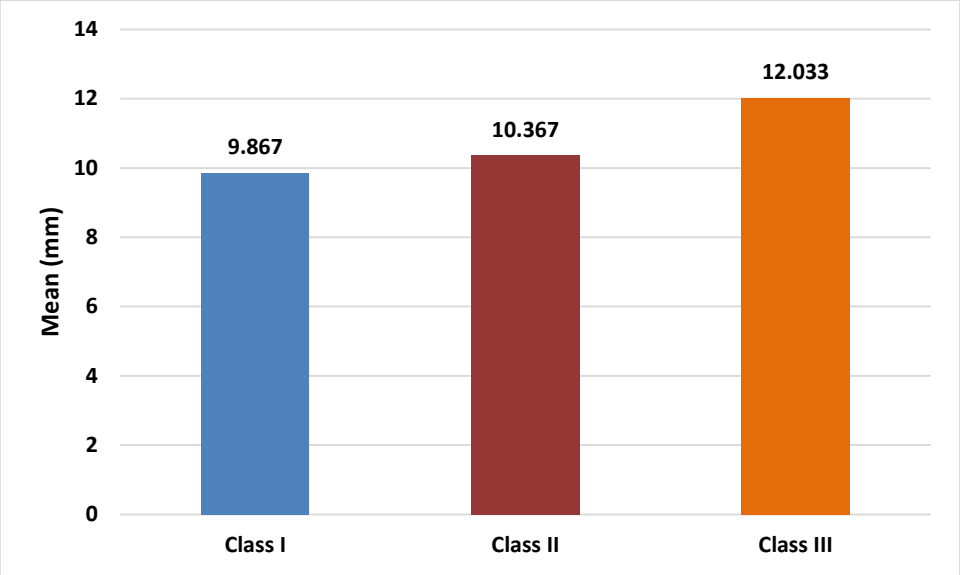
As variations are seen in different population groups with respect to prevalence of type of malocclusion[2,3,10], it was expected that condylar and glenoid fossa position might also vary between subjects of different racial or ethnic origin. The trend for glenoid fossa position was same in studies conducted in different population groups like of Pakistan[10], Srinagar[2], Malaysia and China[9] etc, but glenoid fossa measurements differed in these studies. As variations are anticipated in measurement

of glenoid fossa position, it was decided to evaluate the same in our population. Despite the recognized role of the glenoid fossa in the etiology of malocclusions, as well as during Orthodontic treatment, literature has limited data to explain diagnostic significant of position of glenoid fossa with respect to jaw bases in different malocclusion groups. Hence in this study we decided to evaluate the glenoid fossa position with respect to maxilla and mandibular jaw bases in subjects of North Indian population, using lateral Cephalogram

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi Das College of Dental Sciences, Lucknow. The sample for this study consisted of 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups- Group I (n=30, Class I skeletal malocclusion), Group II (n=30, Class II skeletal malocclusion) and Group III (n=30, Class III skeletal malocclusion) in age range of 18-28 years (mean age 20.5 ±2.5SD years). This sample was selected after screening of 110 subjects with different malocclusion, taken from records as well as from ongoing cases of department. (The type of malocclusion was confirmed using ANB , WITS and YEN angle for selection of final sample.)

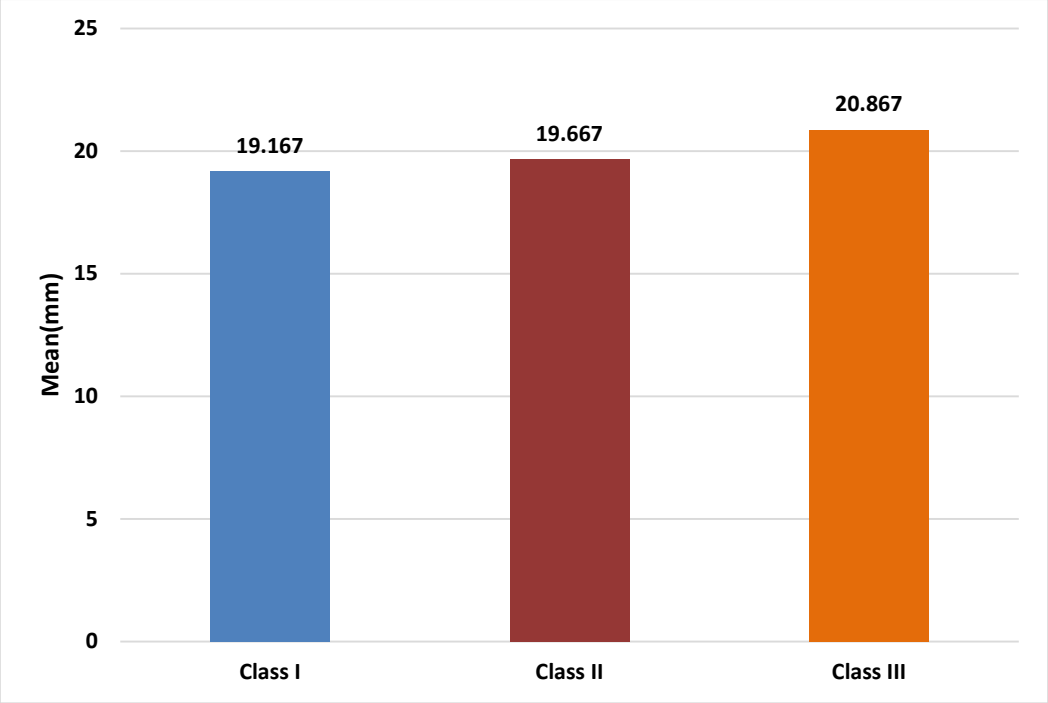
Hand tracing of lateral cephalograms of selected subjects were done and glenoid fossa position was assessed in anteroposterior plane(GF-S horizontal distance) and vertical plane(GF-S vertical distance). Also various parameters were measured to assess effective maxillary and mandibular length (C-M and C-G), Maxillary and mandibular position(N perpendicular to Ptm perpendicular distance and N perpendicular to GF), relation of jaw bases (angle GF-M-G) and mandibular rotation (angle GF-Go-G). Data was tabulated and adequate statistical comparisons were done.

The result of the present study suggested that anteroposterior (horizontal distance GF-S) position of glenoid fossa was more posteriorly located in group III followed by group II and most anteriorly located in group I and their overall inter group comparison showed statistically significant difference(Bar diagram1). On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III.



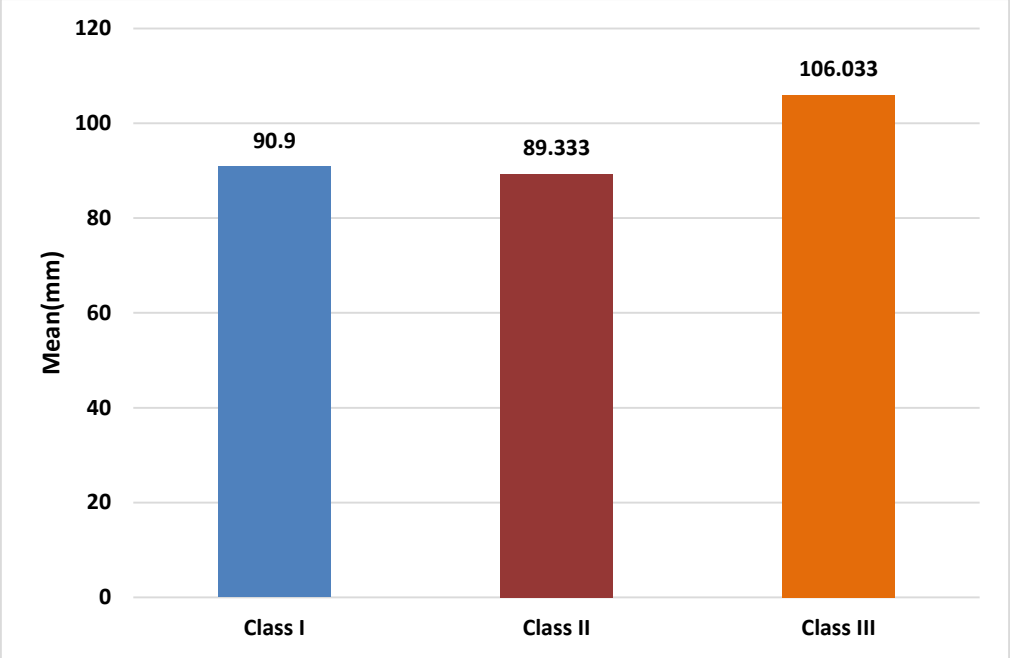
Bar diagram 1: Comparison of Anteroposterior Position of glenoid fossa (horizontal distance GF- S at point H) among groups.

For vertical position(vertical distance GF-S) of glenoid fossa, it was seen that glenoid fossa was most inferiorly located in group III, than group II and was comparatively superiorly located in group I, but their overall intergroup comparison showed statistically non significant difference(Bar diagram 2).



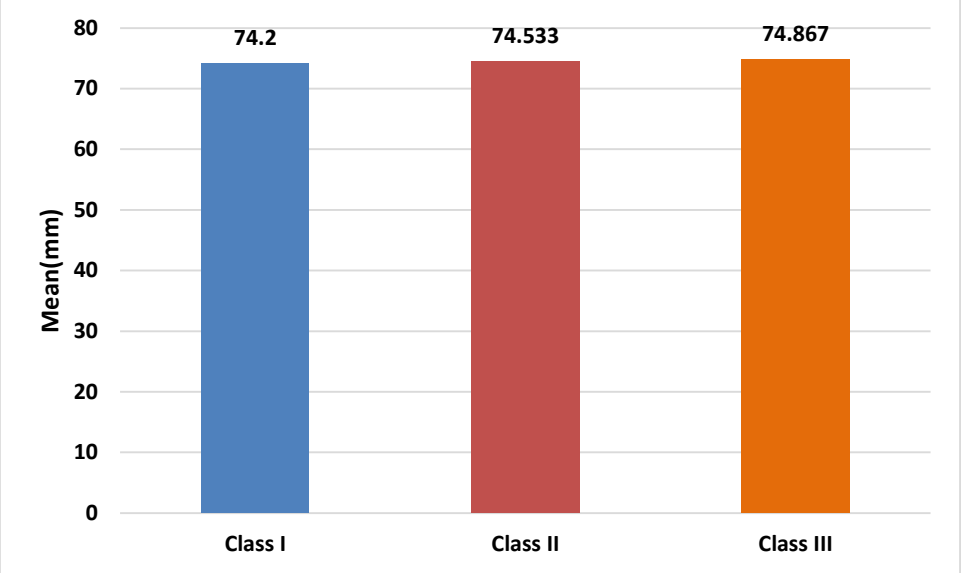
Bar diagram 2: Comparison of vertical Position of glenoid fossa (vertical distance S-GF at point H) among groups.

Mandibular length (C-G distance) was seen as maximum in group III followed by group I and minimum in group II and their overall inter group comparison showed statistically significant difference (Bar diagram 3). On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III.



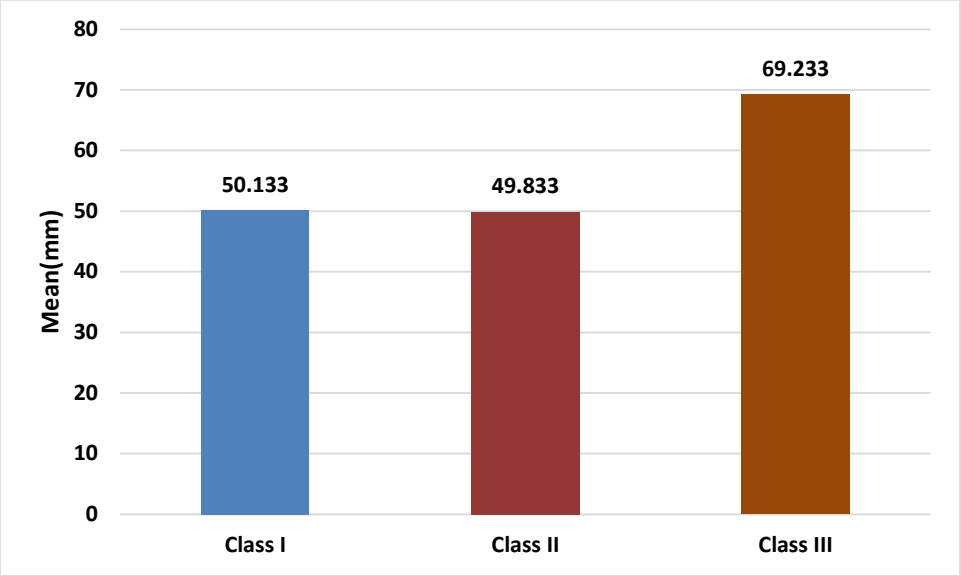
Bar diagram 3: Comparison of mandibular length among groups .

Maxillary length (C-M distance) was seen maximum in group III followed by group II and minimum group I and their overall intergroup comparison showed statistically non significant difference (Bar diagram 4).



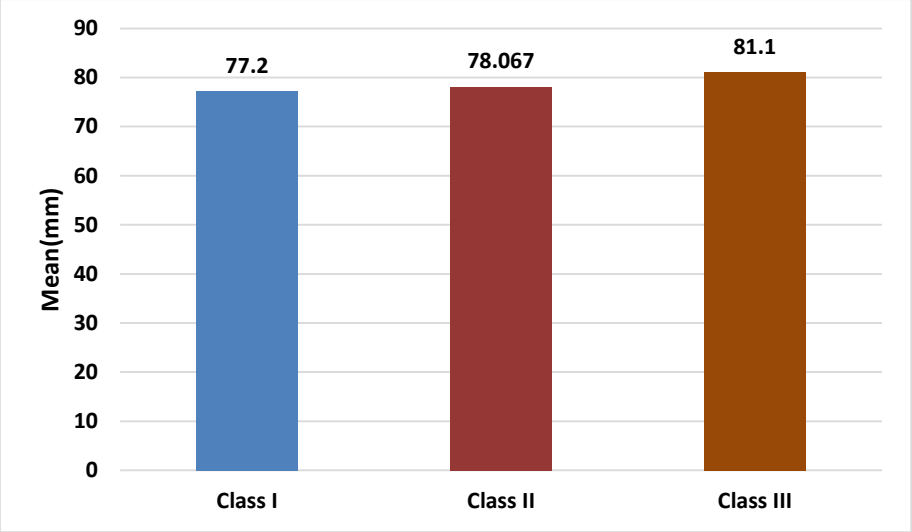
Bar diagram 4 Comparison of maxillary length among groups.

Maxillary position (N perpendicular to Ptm perpendicular distance) was seen maximum in group III followed by group I and minimum in group II and their overall inter group showed statistically significant difference (Bar diagram 5). This suggested maxilla was retrognathic in class III malocclusion as Ptm perpendicular distance from N perpendicular was more in class III malocclusion. On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III.



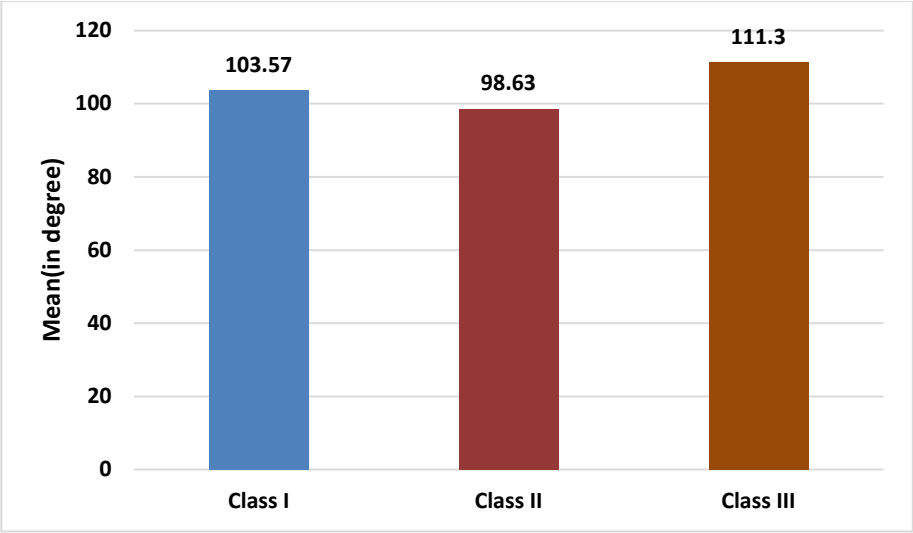
Bar diagram 5: Comparison of maxillary position among groups.

Mandibular position (N perpendicular to GF perpendicular distance) was seen maximum in group III followed by group II and minimum in group I and there overall inter group comparison showed statistically significant difference (Bar diagram 6). This suggested glenoid fossa was more posteriorly located in class III malocclusion. On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III.



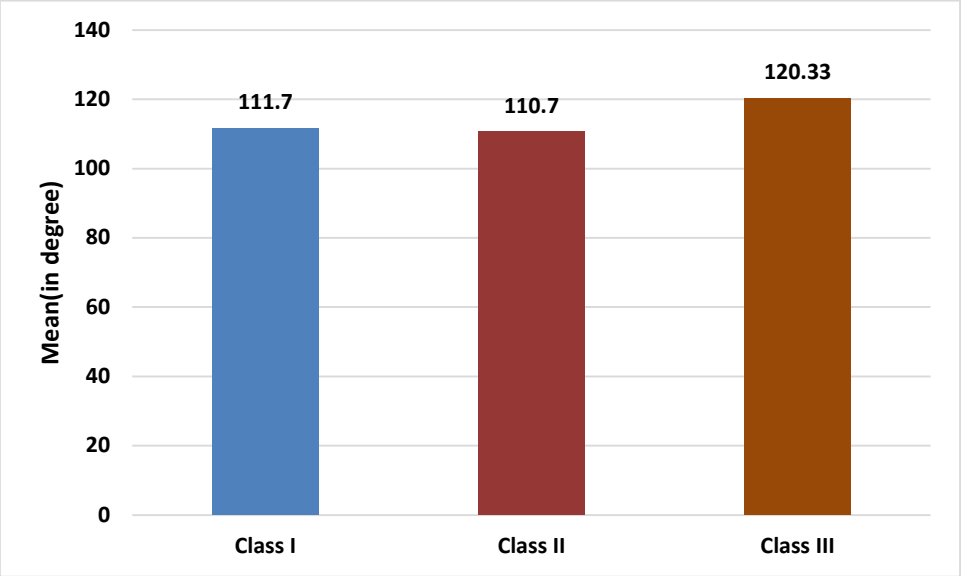
Bar diagram.6: Comparison of mandibular position among groups.

Relation of maxillary and mandibular jaw bases (angle GF-M-G) showed highest value in group III followed by group I and lowest in group II and their overall intergroup comparison showed statistically significant difference. This could be due to the fact that maxilla was retrognathic or mandible was prognathic, there by leading to increased value for this parameter for group III (Bar diagram 7). On individual intergroup comparison, difference was statistically significant between group I vs group II, group I vs group III and group II vs group III.



Bar diagram 7: Comparison of angle GF-M-G among groups.

Angle GF -Go-G had higher value for Group III followed by group I and then group II. As glenoid fossa was more posteriorly located, increased values were seen for this parameters(Bar diagram 8), and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.



Bar diagram 8: Comparison of angle GF-Go-G among groups.

The trend seen in present study for glenoid fossa position was compared to other studies which assessed glenoid fossa position in different malocclusion groups. However none of the studies evaluated these new parameters measured with respect to center of condyle and center of glenoid fossa, hence no direct comparison were possible.

A study by **Qadir M et al(** 2017)[3]on 90 subjects (30 male and 60 female aged between 15 -35years) was done to assess diagnostic significant of Glenoid Fossa Position. They found glenoid fossa was located posteriorly in Class II malocclusion, followed by Class I , than Class III. But this difference was statistically non significant . Articulare and Condylion were used to describe position of glenoid fossa

in terms of linear parameters and articulating surface of glenoid fossa was used for angular parameters. This result is in contrast to our study, as we evaluated glenoid fossa position using center of glenoid fossa not the condylion and articulare which are anatomic landmarks of mandible and they are not representative for actual glenoid fossa position.

Bacceti T et al(1997)[1] and Droel R et al(1972)[5] conducted study on 180 subjects (90 males and 90 females, aged 7–12 years) and on 160 subjects(Droelet al) divided in to three groups respectively. Both of these studies found significantly smaller horizontal distance between glenoid fossa summit and point on supper point of anterior wall of sella turcica in class II malocclusion in comparesion to class III. Glenoid fossa position was more posterior in skeletal Class II when compared with skeletal Class III. In the vertical plane, the position of the glenoid fossa relative to basicranial structures was more caudal in low angle subjects when compared with subjects with normal or high angle vertical relationships. According to the authors vertical level of the glenoid fossa relative to point PNS appears to be an important element in the diagnostic assessment of vertical skeletal relationship. In high angle subjects glenoid fossa was placed more cranially in relation to the position of the posterior extremity of the palate. The result in anteroposterior plane were contrasting , due to difference in methodology of their and present study and results in vertical plane could not be compared as they assessed glenoid fossa position in different growth patterns and not in different skeletal malocclusion as done in the present study.

Nagaraj K et al (2016)[2] conducted a study on 45 subjects aged 12 - 18 years, and divided into three groups(Class I, Class II Div 1 and Class II Div2 malocclusion). They found more posterior position of glenoid fossa in Class II malocclusion(both Div 1 and Div2)in compration to Class I malocclusion. While measuring horizontal

distance between perpendicular from glenoid fossa summit to sella nasion line and point sella. This is contradictory to our results , and it may be due to difference in methodology. In vertical plane distance between glenoid fossa summit and sella showed statistically non significant difference(Class I >Class II) and low level of corelation between different malocclusion groups, hence they divided groups according to mandibular rotation . This result in vertical plane is similar to our study where vertical distance was more in group I than group II, and difference was statistically non significant.

Mengi A et al(2016)[3] conducted a study on 84 subjects and divided the sample in three groups skeletal class I, class II, and classIII malocclusion. They made measurement between Articulare, Condylion and supper most point on anterior wall of sella turcica. They found that the glenoid fossa was located significantly more posteriorly in skeletal class II than in class I and glenoid fossa was located significantly more anteriorly in skeletal class III than in class II malocclusion. This result is in contrast to our study, as we evaluated glenoid fossa position using center of glenoid fossa not the condylion and articulare which are anatomic landmark of mandible and they are not representative point of glenoid fossa.

Innocenti C et al(2008)[15] conducted a study on 30 subjects, aged 8 years +_ 6 months, with skeletal and dental Class III malocclusion and compared with control group of 33 subjects with skeletal and dental Class I relationship. The position of the glenoid fossa was evaluated according to summit of glenoid fossa to sella. They found that the Class III malocclusion had a significantly more mesial position of the glenoid fossa than the control group(class I), suggestive of more posterior location of glenoid

fossa class I than Class III malocclusion. This is contradictory to result of present study and the difference could be attributed to difference in age of the sample selected growing subjects were taken in their study. Where as non growing subjects were taken in the present study.

Tabassum R et al(2021)[10] conducted a study on130 patients(age range from 12 to 25 years) divided in to two groups skeletal Class I skeletal Class II malocclusion. In this study, measurements were taken for the evaluation of glenoid fossa position in anteroposterior plane which was measured as distance of glenoid fossa summit to sella (on Frankfort horizontal line). They found that glenoid fossa was located more posterior and distal in subject with class II skeletal malocclusion as compared to the subjects with class I malocclusion. This result is in contrast to our study.

Azzawi AM et al(2010)[17] conducted a study on 124 subjects (aged 18-30years) divided into three groups Class I ,Class II and Class III. In this study position of the glenoid fossa was evaluated according to glenoid fossa summit and point on supperior point of anterior wall of sella turcica. They found that sagittal position of glenoid fossa in Class II was more posterior than Class I followed by Class III. They found significant difference between glenoid fossa position of class II and classIII. The result for in this study I contradictory to our study may be due to difference in method used.

Jeff T et al (1996)[11] conducted a study on 232 subjects (age 9 to 42 years) divided in 5 group based on Angle's classification, Class I, end on end, Class II Div 1, Class II Div 2, Class III malocclusion groups. In their result they found that skeletal and dental Class III subjects showed more anterior position of condyle in relation to glenoid fossa. There was no significant difference in condylar position in relation to glenoid

fossa between Class I and Class II. The result of this study was contradictory to our study.

Kaur A et al (2016)[8] conducted a study on 45 subjects (aged 18 to 42 years) divided into three groups skeletal Class I, Class II and Class III. To assess the condylar position in the glenoid fossa for different malocclusion groups, a template (grid) was used, and measurement were made in sagittal plane. They found that in sagittal plane condyle position in relation to glenoid fossa was more anterosuperior in Class I and Class III and more posterosuperior in Class II malocclusion.

Overall conclusion from above mentioned studies is that results of the present study were conflicting from previous studies regarding Glenoid Fossa position in different malocclusion groups. Thus, results of present study should be validated on larger sample size. The methodology of taking center of Glenoid Fossa in present study was taken to eliminate the errors of exactly locating contour of Glenoid fossa on lateral cephalogram, which was taken in all of the previous studies. This method of locating center of Glenoid fossa was used in study by Prabhu U et al[29] they found that condyle was placed upward and forword, and glenoid fossa was situated more anterior in edentulous subjects compared to dentutous subjects. The difference in location of glenoid fossa could be reason of conflicting results.

Within limitations of present study it can be suggested that Glenoid Fossa in anteroposterior plane was positioned more posteriorly in Class III malocclusion followed by Class II and Class I, and their difference was statistically significant. In vertical plane glenoid fossa was positioned more caudly in Class III followed by Class II and more cranially in Class I malocclusion and their difference was statistically non significant. Glenoid fossa undergoes adaptive remodelling in all subjects, hence

Glenoid fossa position in horizontal and vertical plane in addition to various measurement related to mandibular landmarks must be carefully assessed. Glenoid fossa measurements from center of glenoid fossa could be used in orthodontic diagnosis and treatment planning of different malocclusions.

The further studies can be done on large sample size in north Indian Population as well as in other populations to validate result of present study, also glenoid fossa position can be assessed by using three dimensional techniques like CBCT.

Conclusion

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi Das College of Dental Sciences, Lucknow, 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups- Group I (n=30, Class I skeletal malocclusion), Group II (n=30, Class II skeletal malocclusion) and Group III (n=30, Class III skeletal malocclusion) with an aim to evaluate Glenoid fossa position in different malocclusion groups in subjects of north Indian population.

Following conclusion can be drawn from the present study.

1. Glenoid fossa position in anteroposterior plane showed highest value for group III(most posterior)>group II>group I (most anterior), however their overall inter group comparison showed statistically significant difference. On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III only.
2. Glenoid fossa position in vertical plane showed higher value for group III(inferior most) >II >I (superior most), however their overall inter group comparison was statistically non significant.
3. Mandibular length showed maximum mean value for group III>group I>group II and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.
4. Maxillary length showed maximum value for group III> group II> group I however their overall inter group comparison was statistically non significant.
5. Maxillary position showed maximum mean value for group III> group I> group II, and their overall inter group comparison was statistically significant. On individual

intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.

6. Mandibular position showed maximum value for group III >group II >group I, and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.
7. Angle GF-Go-G (mandibular rotation) showed maximum mean value for group III >group I >group II, and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.
8. Angle GF-M-G(relation between axillary and mandibular jaw bases) showed maximum mean value for group III >group I >group II. and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group II, group I vs group III and group II vs group III only.

   To conclude Glenoid fossa was most posterior in Class III and most anterior in Class II. Glenoid fossa measurement in addition to other parameters related to mandible will aid in Orthodontic diagnosis and treatment planning.

   The further studies can be done on large sample size in north Indian Population as well as in other populations to validate result of the present study, also glenoid fossa position can be assessed by using three dimensional techniques like CBCT.

Summary

Orthodontic treatment aims to achieve a harmonious facial profile and occlusion in all three planes of space-vertical, sagittal and transverse. Mandibular condyle as well as glenoid fossa are important structures of TMJ that helps to sustain good occlusion and balanced stomatognathic system. The morphology of Glenoid fossa and its relation to condyle influences sagittal, vertical and transverse position of jaws, which eventually contribute to development of various malocclusion.

Many studies showed condyle and glenoid fossa differ in shape among patients with different malocclusions. Thus it is assumed that the mandibular position relative to the cranium is highly dependent upon the location of the glenoid fossa, which could be anteriorly or posteriorly located. This highlights the need to consider position of glenoid fossa by orthodontist during diagnosis and treatment planning. Anteroposterior positioning of mandible in different skeletal types (skeletal Class I, II, III malocclusions), can result in alteration in position of condyle with corresponding adaptive change in glenoid fossa, hence it was decided to evaluate glenoid fossa position in these type of skeletal malocclusion in sagittal plane in present study. There are many studies in which position of glenoid fossa has been evaluated using lateral cephalogram and CBCT. However lateral cephalogram taken routinely for subjects undergoing for fixed orthodontic treatment were used to assess glenoid fossa position in present study.

As variations are seen in different population groups with respect to prevalence of type of malocclusion, it was expected that condylar and glenoid fossa position might also vary between subjects of different racial or ethnic origin. The trend for glenoid fossa position was same in studies conducted in different population groups like of Pakistan[11], Srinagar[2], Malaysia and China etc. But glenoid fossa measurements differed in these studies. As variations are anticipated in measurement of glenoid

fossa position, it was decided to evaluate the same in our population. Despite the recognized role of the glenoid fossa in the etiology of malocclusions, as well as during Orthodontic treatment, literature has limited data to explain diagnostic significance of position of glenoid fossa with respect to jaw bases in different malocclusion groups. Hence in this study we decided to evaluate the glenoid fossa position with respect to maxilla and mandibular jaw bases in subjects of North Indian population, using lateral Cephalogram.

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi Das College of Dental Sciences, Lucknow, on 90 pretreatment lateral cephalograms of different sagittal malocclusions, divided into the three groups- Group I (n=30, Class I skeletal malocclusion), Group II (n=30, Class II skeletal malocclusion) and Group III (n=30, Class III skeletal malocclusion) in age range of 18-28 years (mean age 20.5 ±2.5SD years). This sample was selected after screening of 110 subjects with different malocclusion, taken from records as well as from ongoing cases of Department . the type of malocclusion was confirmed using ANB , WITS and YEN angle for selection of final sample . Hand tracing of lateral cephalograms of selected subjects were done and glenoid fossa position was assessed in horizontal (anteroposterior plane) and vertical plane. Also various parameters were measured to assessed effective maxilla and mandibular length (C-M and C-G), Maxillary and mandibular position(N perpendicular (line1) to Ptm perpendicular distance(line-2) and N perpendicular to GF), relation of jaw bases (angle GF-M-G) and mandibular rotation (angle GF-Go-G). after analysis of all the subjects for all the parameters data was tabulated and adequately statical calculation was performed.

The result for the present study are summerised as followes:

1. Glenoid fossa position in anteroposterior plane showed highest value for group III(most posterior)>group II>group I(most anterior), however their overall inter group comparison showed statistically significant difference. On individual intergroup comparison, difference was statistically significant between group I vs group III and group II vs group III only.
2. Glenoid fossa position in vertical plane showed higher value for group III(inferior most) >II >I (superior most), however their overall inter group comparison was statistically non significant.
3. Mandibular length showed maximum mean value for group III>group I>group II and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significance between group I vs group III and group II vs group III only.
4. Maxillary length showed maximum value for group III> group II> group I however their overall inter group comparison was statistically non significant.
5. Maxillary position showed maximum mean value for group III> group I> group II, and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.
6. Mandibular position showed maximum value for group III >group II >group I, and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.
7. Angle GF-Go-G (mandibular rotation) showed maximum mean value for group III >group I >group II, and their overall inter group comparison was statistically

significant. On individual intergroup comparison difference was statistically significant between group I vs group III and group II vs group III only.

8. Angle GF-M-G(relation between axillary and mandibular jaw bases) showed maximum mean value for group III >group I >group II. and their overall inter group comparison was statistically significant. On individual intergroup comparison difference was statistically significant between group I vs group II, group I vs group III and group II vs group III only.

   To conclude Glenoid fossa was most posterior in Class III and most anterior in Class II. Glenoid fossa measurement in addition to other parameters related to mandible will aid in orthodontic diagnosis and treatment planning.

   The further studies can be done on large sample size in north Indian Population as well as in other populations to validate result of the present study, also glenoid fossa position can be assessed by using three dimensional techniques like CBCT.

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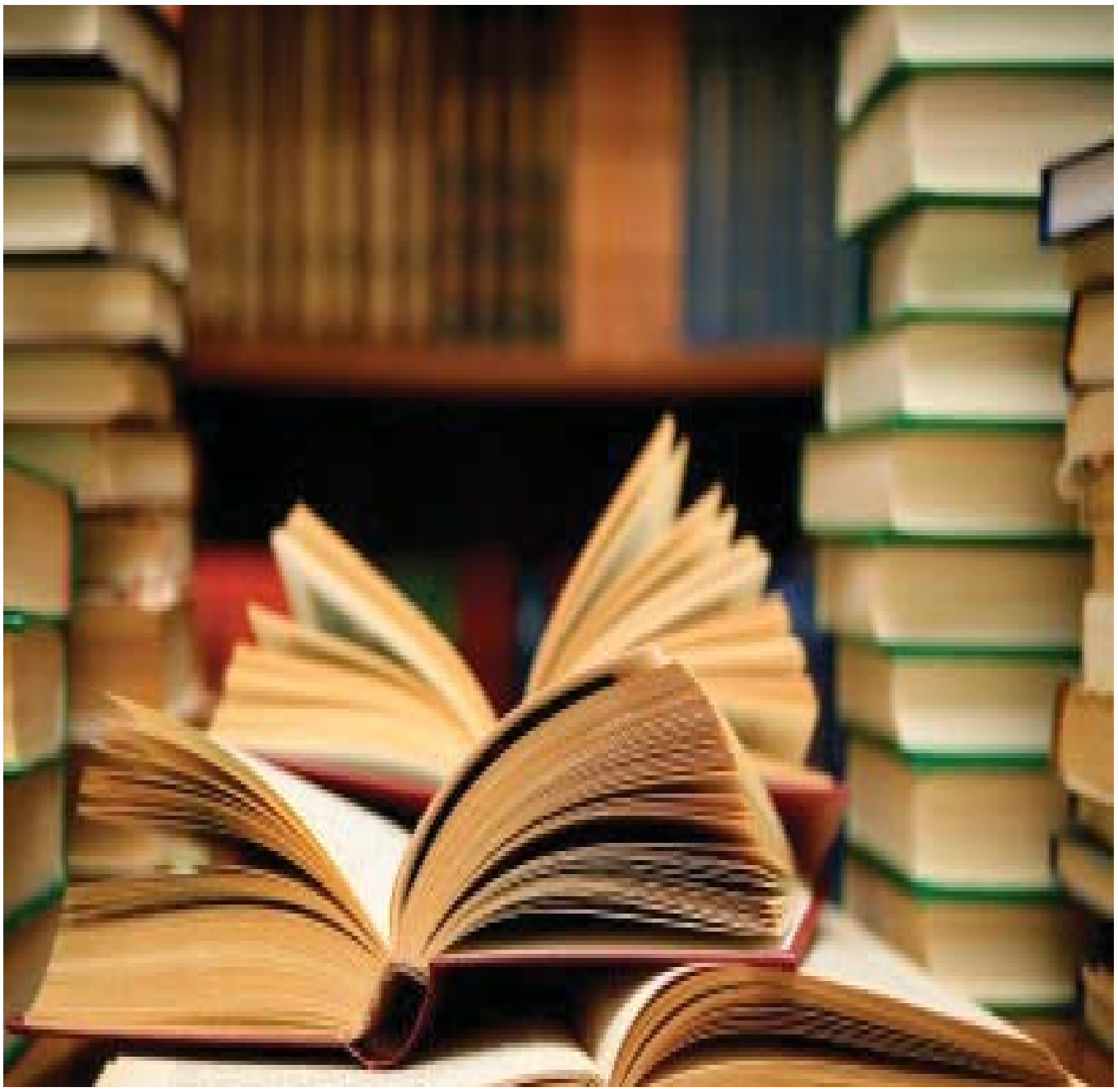

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Annexures