



**CEPHALOMETRIC EVALUATION OF DENTO- SKELETAL  
CHARACTERISTICS OF ANGLE'S CLASS II DIVISION I  
SUBDIVISION MALOCCLUSION AS COMPARED TO ANGLE'S  
CLASS I AND ANGLE'S CLASS II DIVISION I  
MALOCCLUSION.**

**Thesis**

**Submitted to**

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*of*

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**In**

*ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS*

**By**

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**(Faculty of Babu Banarasi Das University)**

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**BATCH: 2015**



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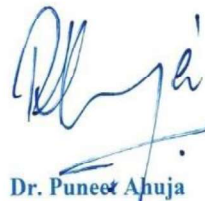
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## TABLE OF CONTENTS

| S.NO. | TITLE                      | PAGE NO. |
|-------|----------------------------|----------|
| 1.    | Introduction               | 1-4      |
| 2.    | Aim & Objectives           | 5        |
| 3.    | Review of Literature       | 6-17     |
| 4.    | Materials and Method       | 18-38    |
| 5.    | Measurement of Reliability | 39-40    |
| 6.    | Observation and Result     | 41-73    |
| 7.    | Discussion                 | 74-90    |
| 8.    | Conclusion                 | 91       |
| 9.    | Summary                    | 92-93    |
| 10.   | References                 | 94-98    |
| 11.   | Appendices                 | 99-119   |

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## LIST OF TABLES

| S.NO. | TITLE                                                                                                                                                 | PAGE NO. |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.    | Showing distribution of sample into groups and subgroups.                                                                                             | 19       |
| 2.    | Reliability Analysis.                                                                                                                                 | 39       |
| 3.    | Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters of Overall Sample of Group I (Class I Malocclusion)                            | 41       |
| 4.    | Descriptive Statistics for Skeletal, Dental, and Soft tissue parameters of Overall Sample of Group II (Class II Division 1 Malocclusion).             | 42       |
| 5.    | Descriptive Statistics for Skeletal, Dental and soft tissue parameters of Overall Sample of Group III (Class II Division 1 Subdivision Malocclusion). | 43       |
| 6.    | Comparative Statistics of Skeletal, Dental and Soft Tissue parameters of overall sample in Group I, II & III.                                         | 44       |
| 7.    | Overall Intergroup Comparison of Skeletal, Dental and Soft Tissue parameters among Group I, Group II and Group III                                    | 48       |
| 8.    | Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for Females of Group I (Class I Malocclusion)                                  | 50       |
| 9.    | Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for Females of Group II (Class II division 1 Malocclusion)                     | 51       |
| 10.   | Descriptive statistics for Skeletal, Dental and Soft Tissue Parameters for females of Group III (Class II division 1 subdivision Malocclusion)        | 52       |
| 11.   | Comparative Statistics of Skeletal, Dental and Soft Tissue Parameters for Females of Group I, II and III                                              | 53       |
| 12.   | Intergroup Comparison of Skeletal, Dental and Soft Tissue Parameters Among Females of Group I, II, III                                                | 58       |
| 13.   | Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for males of Group I (Class 1 Malocclusion)                                    | 60       |

---

---

|            |                                                                                                                                     |           |
|------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>14.</b> | Descriptive Statistics for Skeletal Dental and Soft Tissue Parameters for males of Group II (Class II Division 1 Malocclusion)      | <b>61</b> |
| <b>15.</b> | Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for Group III (Class II Division 1 Subdivision Malocclusion) | <b>62</b> |
| <b>16.</b> | Comparative Statistics of Skeletal, Dental and Soft Tissue Parameters for Males of Group I, II and III                              | <b>63</b> |
| <b>17.</b> | Intergroup Comparison of Skeletal, Dental and Soft Tissue Parameters Among Male of Group I, II, III.                                | <b>67</b> |
| <b>18.</b> | Intragroup comparison between Males Vs Females of Group II (Class II Division 1 Malocclusion)                                       | <b>69</b> |
| <b>19.</b> | Intragroup comparison between males Vs Female of Group III (class II Division 1 subdivision malocclusion)                           | <b>72</b> |

---

## LIST OF FIGURES

| S.NO. | TITLE                                                          | PAGE NO. |
|-------|----------------------------------------------------------------|----------|
| 1-3   | Materials used for preparing study model                       | 20       |
| 4.    | Study model of representative sample of study                  | 21       |
| 5.    | Cephalostat Machine                                            | 22       |
| 6.    | Pretreatment lateral cephalogram uploaded in Nemoceph Software | 23       |
| 7.    | Subject positioning while taking Lateral Cephalogram.          | 25       |
| 8.    | Hard tissue landmarks used in the study                        | 27       |
| 9.    | Soft tissue landmarks used in the study                        | 29       |
| 10.   | Reference Line and plains used in study                        | 31       |
| 11.   | Skeletal Parameters used in the study                          | 33       |
| 12.   | Dental parameters used in the study                            | 35       |
| 13-14 | Soft tissue parameter used in the study                        | 37-38    |

---



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## LIST OF GRAPHS

| S.NO. | TITLE                                                                                                                                                  | PAGE NO. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.    | Descriptive Statistics for Skeletal, Dental and soft tissue Parameters of overall Sample of Group I (Class I Malocclusion)                             | 76       |
| 2.    | Descriptive Statistics for Skeletal , Dental and soft tissue Parameters of Overall Sample of Group II (Class II Division 1 Malocclusion)               | 77       |
| 3.    | Descriptive Statistics for Skeletal , Dental and soft tissue Parameters of overall Sample of Group III (Class II Division 1 Subdivision Malocclusion). | 77       |
| 4.    | Overall Intergroup comparison of Skeletal Parameters of Group I, II & III                                                                              | 78       |
| 5.    | Overall Intergroup Comparison of Dental Parameters of Group I, II & III.                                                                               | 78       |
| 6.    | Overall Intergroup Comparison of Soft Tissue Parameters of Group I, II & III.                                                                          | 79       |
| 7.    | Descriptive Statistics for Skeletal Parameters for females (Group Ib, IIb, IIIb)                                                                       | 81       |
| 8.    | Descriptive Statistics for Dental Parameters for females Group (Ib, IIb, IIIb).                                                                        | 82       |
| 9.    | Descriptive Statistics for Soft Tissue Parameters for females (Group Ib, IIb, IIIb)                                                                    | 82       |
| 10.   | Descriptive Statistics of Skeletal Parameters for males (Group Ia,IIa,IIIa).                                                                           | 84       |
| 11.   | Descriptive Statistics for Dental Parameters for males (Group Ia, IIa, IIIa).                                                                          | 84       |
| 12.   | Descriptive Statistics for Soft Tissue Parameters for males (Group Ia,IIa,IIIa).                                                                       | 85       |
| 13.   | Intragroup comparison of Skeletal parameters (Group IIa & IIb).                                                                                        | 86       |
| 14.   | Intragroup comparison of Dental parameters (Group IIa & IIb ).                                                                                         | 86       |

---

---

|            |                                                                      |    |
|------------|----------------------------------------------------------------------|----|
| <b>15.</b> | Intragroup comparison of Soft tissue parameters (Group IIa & IIb).   | 87 |
| <b>16.</b> | Intragroup comparison of Skeletal parameters (Group IIIa & IIIb).    | 87 |
| <b>17.</b> | Intragroup comparison of Dental parameters (Group IIIa & IIIb).      | 88 |
| <b>18.</b> | Intragroup comparison of Soft tissue parameters (Group IIIa & IIIb). | 88 |

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## LIST OF APPENDICES

| S.NO.             | TITLE                                                                     | PAGE NO.       |
|-------------------|---------------------------------------------------------------------------|----------------|
| <b>APPENDIX-1</b> | INSTITUTIONAL REASEACH<br>COMMITTEE APPROVAL                              | <b>99</b>      |
| <b>APPENDIX-2</b> | ETHICAL COMMITTEE APPROVAL                                                | <b>100</b>     |
| <b>APPENDIX-3</b> | CONSENT FORM-ENGLISH                                                      | <b>101-104</b> |
| <b>APPENDIX-4</b> | CONSENT-HINDI                                                             | <b>105-107</b> |
| <b>APPENDIX-5</b> | GROUP I (CLASS I MALOCCLUSION)<br>SUBJECT                                 | <b>108</b>     |
| <b>APPENDIX-6</b> | GROUP II (CLASS II DIVISION 1<br>MALOCCLUSION) SUBJECTS                   | <b>109</b>     |
| <b>APPENDIX-7</b> | GROUP III (CLASS III DIVISION 1<br>SUB DIVISION MALOCCLUSION)<br>SUBJECTS | <b>110</b>     |
| <b>APPENDIX-8</b> | FORMULATION USED FOR<br>STATISTICAL ANALYSIS                              | <b>111-116</b> |
| <b>APPENDIX-9</b> | PLAGIARISM REPORT                                                         | <b>117-119</b> |

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## ABBREVIATION

| S.No. | ABBREVIATION | FULL FORM                                            |
|-------|--------------|------------------------------------------------------|
| 1.    | ANS          | Anterior nasal spine                                 |
| 2.    | Cd           | Condylion                                            |
| 3.    | CD ROM       | Compact Disk Read Only Memory                        |
| 4.    | G            | Glabella                                             |
| 5.    | Gn'          | Soft tissue Gnathion                                 |
| 6.    | Gn           | Gnathion                                             |
| 7.    | Go           | Gonion                                               |
| 8.    | Li           | Labrale Inferius                                     |
| 9.    | Ls           | Labrale superius                                     |
| 10.   | Me           | Menton                                               |
| 11.   | N            | Nasion                                               |
| 12.   | N'           | Soft tissue nasion                                   |
| 13.   | Or           | Orbitale                                             |
| 14.   | Pg           | Pogonion                                             |
| 15.   | Pg'          | Soft tissue Pogonion                                 |
| 16.   | PNS          | Posterior nasal spine                                |
| 17.   | Po           | Porion                                               |
| 18.   | Point A      | Point A                                              |
| 19.   | Point B      | Point B                                              |
| 20.   | Ptm          | Apex of the teardrop shaped Pterygomaxillary fissure |
| 21.   | S            | Sella                                                |
| 22.   | Sn           | Subnasale                                            |

## ABSTRACT

**Aim:** To evaluate and compare the cephalometric Dento- skeletal characteristics of Angle's Class II Division 1 malocclusion subdivision malocclusion with that of Angle's Class I and Angle's Class II Division 1 malocclusion.

**Materials and Methods:** The sample included pre-treatment Lateral Cephalograms of 90 subjects, divided in three Groups-Group I (n=30) subjects with Class I malocclusion, Group II ( n=30) subjects with Class II Division 1 malocclusion and Group III (n=30) subjects with Class II Division I subdivision malocclusion. A total of 21 parameters were evaluated by Nemotech (NX, version 6.0) software to assess skeletal, dental and soft tissue parameters of the face. The adequate comparisons were made between different groups by SPSS software (version 21.0).

**Results:** Overall Inter group comparison showed that SNA , LI-NB, Nasolabial angle had statistical significant differences for group I verses II, whereas group I verses III and group II verses III did not show statistically significant difference.

For ANB Angle, significant statistical difference was seen only for group I verses group III, whereas group II verses III and group I verses group II did not show significant statistical difference. Rest of the parameters did not showed statistically non significant differences among groups.

**Conclusion-** Skeletal and Dental characterstics of Class II division 1 subdivision malocclusion did not show definite swing towards Class II division 1 or Class I malocclusions.

**Keywords-** Class II division I subdivision malocclusion ,Nasolabial angle , Class II division I malocclusion .

## **INTRODUCTION**

Improving patient aesthetics is one of the main goals of Orthodontic treatment, which cannot be achieved without thorough diagnosis of the case. Orthodontic diagnosis involves assessment of the face in all three dimensions anteroposterior, vertical and transverse both clinically and radiographically.<sup>[1]</sup>

The preliminary step for accurate diagnosis is to classify the actual dental occlusion of the patient. Dr. E.H. Angle' was a pioneer Orthodontist who classified malocclusion in 1887 as Class I, Class II and Class III malocclusion, Class I malocclusion exists when the anteroposterior relationship of maxillary and mandibular molars is correct with the mesiobuccal cusp of maxillary first molar occluding in the mesiobuccal groove of the mandibular first molar but there is presence of individual tooth irregularities like rotations, tooth malposition's, missing teeth and tooth size discrepancies? In Class II malocclusion, the mandibular arch is in a distal relationship to the maxillary dental arch with distobuccal cusp of maxillary first molar occluding in the mesiobuccal groove of mandibular first molar. Class I malocclusion was further classified in Class I Division 1 and Class I Division 2 malocclusion. In Class II Division I malocclusion, maxillary arch is narrow, there is labioversion of maxillary incisors with increased overjet, mandibular anterior teeth show supraversion or overeruption and there is aberrant muscle activity of buccinator, tongue and mentalis. In Class II Division 2 malocclusion there is lingual inclination of maxillary central incisors and labial inclination of lateral incisors, or there may be lingual inclination of all the four incisors with canines overriding the lateral incisors, deep bite, trauma to mandibular labial gingival tissues and normal muscle function. Both the divisions may have subdivision where the molar relationship is Class 1 on one side and Class II on the other side. In Class III malocclusion the mandibular arch is in a mesial relationship to the maxillary arch and mesiobuccal cusp of maxillary first molar occludes in the embrasure of mandibular first and second molar and mandibular incisor are frequently in total cross bite and labial to maxillary incisors. Class II subdivision malocclusion are extremely challenging for diagnosis and treatment planning as its difficult to ascertain the cause of the malocclusion, that is skeletal, dental or combination of both.<sup>[2]</sup>

Subdivisions are a frequent finding in Class II Division I malocclusion. Janson<sup>[3]</sup> found its prevalence to be 38.63 % and Alkofide EA<sup>[4]</sup> found it to be 45%. In a study

by Divder Preet Singh<sup>[5]</sup> the prevalence of Angle's Class II Division I was found maximum followed by Angle's Class II Division 1 subdivision and then Angle's Class II Division 2 malocclusion.<sup>[2]</sup>

Dental asymmetries and midline deviation are inevitable in class II subdivision malocclusions previous investigation by Woo, Tildes-ley<sup>[6]</sup>, Pearson<sup>[7]</sup> and Woo. Björk and Björk<sup>[8]</sup> Gundara<sup>[9]</sup> and Zivanovic, Sing<sup>[10]</sup>, and White<sup>[11]</sup> have all shown craniofacial asymmetry to be common in most persons. Vazquez<sup>[12]</sup>, Grostic, and Fonder<sup>[13]</sup> compared indices of skull asymmetry and malocclusion and found asymmetry to be related to severe malocclusion.<sup>[3][4]</sup>

It is crucial to carefully diagnose asymmetries found in Class II malocclusions so they can be properly analyzed to determine the correct etiology and treatment protocol for the malocclusion. Treatment outcomes of Angle Class I subdivision malocclusions may be compromised because of the uncertainty of the etiology.<sup>[3]</sup> **Alavi et al**<sup>[14]</sup> observed that Class II subdivision results mainly from asymmetry of the mandibular first molar. However, they did not determine whether this was due to dentoalveolar or skeletal asymmetry<sup>[14]</sup>, **Rose et al**<sup>[15]</sup> confirmed that the Class II subdivision occurred in general by distal positioning of the mandibular first molar on the Class II side<sup>[5][6]</sup>. Janson et al<sup>3</sup> concluded that the component that contributed to the asymmetric anteroposterior relation in Class I subdivision malocclusion was mainly dentoalveolar and the primary cause was as the distal position of the mandibular first molar on the Class II side in mandible without unusual skeletal or positional asymmetries<sup>[7][8]</sup>. **Azevoda et al**<sup>[16]</sup> and **Brin et al**<sup>[17]</sup> stated that although slight degrees of facial asymmetry are obvious among the general population but the individuals with Class II subdivision typically present an accentuated degree of asymmetry that involves the lower third of the face and the mandible. **Meloti et al**<sup>[18]</sup> found greater mandibular asymmetry in subdivision malocclusions. These cases pose difficulty not only during orthodontic treatment but also in post retention stability where the subdivision side has a tendency to relapse<sup>[17]</sup>.

Correcting the anteroposterior relation and achieving a Class I molar relation in subdivision cases can be very difficult. Unilateral mechanics directed at bringing one of the buccal segments anteriorly or posteriorly, is one method that can be used during treatment of the mandibular arch<sup>[4]</sup>.

Amongst primary factors contributing to class II subdivision malocclusion is distal positioning of mandibular 1<sup>st</sup> molar on class II side, secondary Contributor is mesial

positioning of a Maxillary first molar on Class II side. Therefore, a mandibular dental midline deviation to Class II side is more frequent than maxillary dental midline deviation to opposite side as seen as posteroanterior radiographs. There are two main types of Class II Subdivision malocclusion types 1 and types 2 respectively<sup>[17]</sup>.

The other contributors to the origin of this asymmetric malocclusion could be skeletal or functional that have not been widely studied in previous studies. **Li et al**<sup>[19]</sup> in their study found that the asymmetric position of the glenoid fossa was the most significant skeletal asymmetry with no obvious dentoalveolar asymmetry whereas functional deviation was seen in 32.6% of individuals as a result of disharmonious arch width between maxillary and mandibular dental arches in the premolar section.<sup>[9]</sup>

While observing maxillary and mandibular changes in Class II subdivision and Class I malocclusions, **Janson et al**<sup>[3]</sup> showed that dentoalveolar changes occurred in jaws without positional asymmetry<sup>[9]</sup>. The main cause of Class II subdivision relationship was the distal position of lower molars on the Class II side. The position of upper mesial molars, also on the Class II side, was a secondary cause<sup>[18]</sup>. The lower dental midline also presented more frequent deviations on the Class II side than the upper dental midline did. Therefore, this study as well as others demonstrated that asymmetries present in Class II subdivision patients are mainly of dentoalveolar origin. Computed tomography is considered an optimal diagnostic method for asymmetry assessment. The Photographs have been compared to posteroanterior radiographs, but no significant correlation has been found between methods.<sup>[14]</sup>

**Edler et al**<sup>[20]</sup> argued that photographs should be used simultaneously with posteroanterior radiographs. When photographs were compared to submentovertebral radiographs and posteroanterior radiographs, a small correlation was found between methods<sup>[9][13]</sup>. Posteroanterior radiographs allow observations of vertical and transversal changes, a greater change in the anteroposterior positioning of molars in Class II subdivision malocclusion<sup>[14]</sup>. Although anteroposterior changes can be observed with submentovertebral radiographs, **Lew and Tay**<sup>[53]</sup> found a distortion in linear measurements taken with these radiographs. Additionally, **Arnold et al**<sup>[22]</sup> reported difficulties in using submentovertebral radiographs<sup>[22]</sup>.

The use of 45° cephalometric radiographs offers another method that allows visualization of structures in the anteroposterior direction, but this method is not routinely applied because it requires two further radiographic images in addition to those required for basic orthodontic documentation.

Study models may be used for observation of dental structures in the anteroposterior direction, but these models do not allow skeletal observations<sup>[14]</sup>. The panoramic radiographs do not enable anteroposterior morphological alterations to be visualized, because they are traditionally required for orthodontic treatment, lateral cephalometric radiographs allow visualization of anteroposterior structures in a simple manner lateral cephalometric radiographs to observe the position of molars and the existence of an asymmetrical mandibular relationship in the anteroposterior direction.

Therefore, the objectives of our study were to use lateral cephalometric radiographs to identify skeletal and dentoalveolar morphological alterations in cases of Class II subdivision; to compare these changes with morphology of Class I and Class II; and to assess the incidences of dental and skeletal symmetry and asymmetry of the maxilla and mandible<sup>[14]</sup>.

Considering this it was decided to evaluate if skeletal features of Angle's class II subdivision malocclusion is of more towards Class I or Class II malocclusion. Most studies related to assessment of dentoalveolar asymmetry have used dental models, Lateral cephalometric, posterior cephalometric radiographs or CBCT. Lateral cephalogram allows anteroposterior structures to be visualized in a simple manner without additional costs to the patient, as they are traditionally required for diagnosis and treatment planning. Lateral cephalogram is available and routinely advised as an essential diagnostic aid in my institution.

Hence, it was decided to evaluate the swing of skeletal characteristics of Angle's Class II Division 1 subdivision malocclusion towards skeletal Class I or skeletal Class II malocclusions on lateral cephalogram using Nemoceph software.<sup>[3]</sup>

## **AIM & OBJECTIVES**

### **AIM**

To evaluate and compare the cephalometric skeletal characteristics of Angle's Class II Division 1 subdivision malocclusion with that of Angle's Class I and Angle's Class II Division 1 malocclusion.

### **OBJECTIVES**

1. To evaluate the cephalometric skeletal characteristics of Angle's Class II Division I subdivision malocclusion
2. To evaluate the cephalometric skeletal characteristics of Angle's Class I malocclusion.
3. To evaluate the cephalometric skeletal characteristics of Angle's Class II Division 1 malocclusion.
4. To compare the cephalometric skeletal characteristics of Angle's Class II Division 1 subdivision malocclusion with that of Angle's Class I and Angle's Class II Division 1 malocclusion.

## **REVIEW OF LITERATURE**

**Alavi GD, BeGole AE, Schneider JB (1988)<sup>[14]</sup>** The study was to determine significant differences that exist with respect to dental arch and facial asymmetries between persons having Angle's Class II subdivision malocclusions, and persons having normal occlusion. The sample consisted of 28 subjects in each of the two groups with permanent teeth including first molars. The average age of subjects in both groups was 17 years. A significant discrimination between the two groups resulted in variables describing asymmetry of the mandible appearing to be the primary contributors, whereas asymmetry of the maxillary dentoalveolar region appeared to be both secondary contributing factors.

**Hamdan MA, Rock PW (2001)<sup>[23]</sup>** To identify cephalometric norms for a Jordanian population. A cross sectional study using a sample selected on the basis of a balanced face and a Class I occlusion. 65 subjects aged 14-17 years were selected from a larger sample on the basis of Class I incisors, a balanced profile and no previous orthodontic treatment. Lateral skull radiographs were digitised directly to produce values for SNA, SNB, ANB, UI/MX, LI/MN, UI/LI, MMPA and LI/A-Pog. SNA and SNB were very close to the Eastman Standards. MMPA was significantly lower in Jordanians whilst UI/MX and LI/MN were significantly higher. Lower incisors were 4-6mm further forward in relation to A-Pog in Jordanians.

**Janson G, Metaxas A, Woodside DG, de Freitas MR, Pinzan A (2001)<sup>[3]</sup>** Conducted a study to determine if any significant differences existed with regard to dental and skeletal asymmetries between 30 subjects with Angle Class II subdivision malocclusions (mean age 15.76 years) and 30 subjects with normal occlusions (mean age 22.42 years). Measurements were obtained with the use of submentovertex, posteroanterior, and corrected oblique cephalometric radiographs. Variables were analyzed with multivariate logistic regression analysis. The posteroanterior radiographic analysis showed that the more frequent distal positioning of the mandibular molars on the Class II side, compared with the mesial positioning of the maxillary molars on that side resulted in mandibular dental midline deviation to the Class II side more frequently than the maxillary dental midline to the opposite side.

**Alkofide AE et al (2001)<sup>[4]</sup>** The purpose of this study was to determine the frequency of occurrence of subdivisions, in Class II division 1 malocclusions. Sixty patients seeking orthodontic treatment at the dental college of King Saud University were

selected. The results revealed that 45% of Class II division 1 patients examined had subdivisions. Mandibular shift upon closure was noted in 36% of the subdivision cases. Mandibular asymmetry was noted in 62.6% of the patients. It can be concluded from this study that subdivisions are a frequent finding in Class II division 1 malocclusions.

**Sayin MO, Turkkahraman H et al (2004)<sup>[24]</sup>** This study evaluates dental arch and alveolar widths of patients with Class II, division I malocclusion. 30 female patients with Class II, division 1 malocclusion were compared with 30 female subjects with Class I ideal occlusion. Arch widths measured between maxillary second premolars and maxillary first molars were found narrower in the Class II, division I group, and mandibular intercanine widths were narrower in the Class I group. Inter-alveolar widths showed no difference between the groups. Therefore, slow maxillary expansion rather than rapid maxillary expansion may be considered before or during the treatment of Class II, division 1 patients.

**Freitas DRM, Santos DCAM, Freitas DSMK, Janson G et al (2004)<sup>[25]</sup>** This Orthodontic study showed the growth and development of the craniofacial structures. In this study, skeletal cephalometric characteristics of Class II, division 1 malocclusion were assessed in lateral cephalograms. The experimental sample comprised 55 white Brazilian individuals of both genders, with an ANB angle of 4.5 degrees or higher. The mean age of the subjects was 13.5 years. Steiner and McNamara cephalometric analyses were used in order to evaluate the relation between angular and linear positions of the apical bases, the dental and cranial structures comparing with the values obtained in the control group (available at Bauru Dental School-USP). The results showed that the maxilla was well positioned in relation to the cranial base and maxillomandibular relation showed an increased overjet. No statistically significant difference between genders was found.

**Uysal ,T, Memili B , Serdar, Usumez S, Sarid Z et al(2005)<sup>[21]</sup>** The transverse dimensions of the dental arches and alveolar arches in the canine, premolar, and molar regions of Class II division 1 and Class II division 2 malocclusion groups with normal occlusion subjects. This study was performed using measurements on dental casts of 150 normal occlusion 106 Class II division 1 and 108 Class II division 2 malocclusion subjects. Independent-samples t-test was applied for comparisons of the groups. These findings indicate that the maxillary interpremolar width, maxillary canine, premolar and molar alveolar widths, and mandibular premolar and molar alveolar widths were

significantly narrower in subjects with Class II division 1 malocclusion than in the normal occlusion sample. The maxillary interpremolar width, canine and premolar alveolar widths, and all mandibular alveolar widths were significantly narrower in the Class II division 2 group than in the normal occlusion sample. The mandibular intercanine and interpremolar Wirth were narrower and the maxillary intermolar width measurement was larger in the Class II division 2 subjects when compared with the Class II division 1 subjects. That result rapid maxillary expansion rather than slow expansion may be considered before or during the treatment of Class II division 1 patients.

**Palomo Martin Juan, Hunt W Donald et al (2005)<sup>26</sup>** The objective of this study was to compare longitudinal changes in the shape and size of craniofacial structures between 16 untreated Class II Division 1 girls and 16 untreated Class I Bolton girls. Procrustes analyses were used to compare differences in 30 cephalometric landmarks that were 3-dimensional. Comparisons included shape and size differences between adjacent age groups at ages 6, 11, and 15 in the Class II sample as well as between the Class I and Class II samples at each age. Compared with the Class I sample, the Class II sample had (1) a longer facial pattern, (2) the smallest mandibular shape difference at age 6 and the largest at age 15, and (3) more protrusive maxillary landmarks at all ages compared with the Class I sample. The Class II sample also had the largest change in size from ages 11 to 15 (6.5%), whereas the Class I sample showed the greatest size change (10.5%) from ages 6 to 11. Clinically significant size and shape differences were observed during growth and development between Class II and Class I subjects in this sample.

**Azevedo AR, Janson G, Henriques JF, Freitas MR (2006)<sup>[16]</sup>** Compared the degree of skeletal asymmetry between 23 subjects with Class II subdivision malocclusion (mean age, 15.78 years) and 30 subjects with normal occlusions (mean age, 22.42 years). Radiographic asymmetry was assessed by measuring the relative difference in spatial position of dental and skeletal landmarks between right and left sides in both anteroposterior and transverse dimensions in the submentovertex and in the transverse and vertical dimensions in the posteroanterior radiographs. The main component of Class II subdivision is dentoalveolar, primarily distal positioning of the first mandibular molar on the Class II side and secondarily mesial positioning of the first maxillary molar on the same side

**Gasgoos SS, Saleem ARN, Awni MK(2007)<sup>[27]</sup>** Identified the cephalometric features of three skeletal jaw relations (Class 1, II and III). one hundred thirty-four students were selected aged (12-15) years. 45 with Class I normal occlusion as control, 44 with Class II malocclusion and 45 with Class III malocclusion, after taking the lateral cephalometric radiographs according to ANB angle. 20 variables (12 angular and 8 linear) were used in this study to correlate these variables in the three skeletal Classes. The result concluded that Most of the angular and linear measurements indicated that the skeletal differences between the Class 1, Class II and Class III are concentrated with in the maxillary and mandibular bases in both the anteroposterior and vertical dimensions and their type of articulation. The dental measurements appear to be compensated with that of skeletal one. Also, these variables showed no significant sex differences in the majority of their measurements

**WU J, Urban Hagg U, Bakr MA, Rabie (2007)<sup>[19]</sup>** To establish cephalometric norms of McNamara's analysis in young Chinese and compare them to those of a matched young Caucasian sample. Materials and Methods: The material comprised lateral cephalometric radiographs of a random sample of 200 male and 205 female 12-year-old southern Chinese children, and an additional sample of 43 male and 43 female 12-year-old British Caucasian children in Hong Kong. The radiographs were digitized twice with the CASSOS program. The results showed that there were statistically significant gender differences for six out of the 11 cephalometric variables in the Chinese, but for only one variable in the Caucasians statistically. The size of the observed statistically significant ethnic differences varied from -1.8 to 1.6 on SD scores. The use of specific standards for Chinese, separate for gender, for McNamara's cephalometric analysis seems to be justified.

**Bader AB, Vasiliauskas A, Qadri SA(2008)<sup>[28]</sup>** To compared skeletal and dentoalveolar morphology in Class II division I malocclusion of Lithuanian and Jordanian females. The sample consisted of 60 standardized lateral cephalograms (30 Jordanian - 30 Lithuanian). The mean age of the subjects was  $14.8 \pm 1.11$  years. cephalometric comparison for 5 linear and 10 angular cephalometric variables were made. Repeating Unpaired t-test was performed to assess the difference of malocclusion between both groups. Results showed that Lithuanian females had reduced vertical skeletal relationship in their Class II division 1 malocclusion, while Jordanian females characterized by increased vertical relationship. Dentoalveolar

measurements showed a significant proclination of the mandibular incisors in Jordanian females compared with Lithuanians.

**Kurt G, Uysal T, Sisman Y, Ramoglu IS (2008)<sup>[29]</sup>** Evaluated the condylar and ramal mandibular asymmetry in a group of patients with Class II subdivision malocclusion to identify possible gender differences. Mandibular asymmetry measurements (condylar, ramal, and condylar-plus-ramal asymmetry values) were performed on the panoramic radiographs of 80 subjects (34 male and 46 female). No gender-related difference was found for any of the asymmetry indices. Except for condylar ramal and condylar-plus-ramal height measurements, Class II subdivision patients have symmetrical condyles when compared to normal occlusion samples according to Habbet's mandibular asymmetry indices.

**Tiziano Baccetti T, Lorenzo Franchi L, Kimb HL (2009)<sup>[30]</sup>** The aim of this cephalometric study was evaluated the role of timing in relation to skeletal maturity on the outcomes of no extraction comprehensive Class II therapy. Three samples of patients with Class II Division 1 malocclusion were treated with headgear combined with fixed appliances and Class II elastics. Lateral cephalograms were taken of all subjects before therapy (T1) and at an average interval of 6 months after therapy (T2). The first sample (23 subjects) was treated before the pubertal growth spurt, the second sample (24 subjects) received therapy during the pubertal growth spurt, and the third sample (13 subjects) was treated at a post pubertal stage of development. The average T1 to T2 interval was approximately 30 months for all patients, with an average treatment duration of 24 months. The result showed greatest amount of dentoskeletal correction of Class II malocclusion with 1-phase no extraction treatment occurred in patients treated during the pubertal growth spurt.

**Emad A A, Khateeb AL, Susan N, AL-Khateeb (2009)<sup>[31]</sup>** To describe and analyse the skeletal and dental characteristics associated with Class II division 1 (Class II/1) and Class II division 2 (Class II/2) malocclusions in the anteroposterior and vertical dimensions. A total of 551 lateral cephalograms were used; 293 films of Class II/1 and 258 films of Class II/2 malocclusions. Lateral cephalography were traced and analysed. Parameters for both malocclusions were compared with each other and with the norms calculated for the Jordanian population in another study. The maxilla was prognathic in both malocclusions. The mandible was retrognathic in Class II/1 and orthognathic in Class II/2. Vertically, LAFH was significantly reduced in patients with Class II/2 compared with subjects with Class II/1 who exhibited a significantly

increased LAFH. In Class 11/1, the lower incisors were proclined and the interincisal angle was reduced, while in Class 11/2 the lower incisors were at a normal inclination and the interincisal angle was significantly increased. Class 11/2 may be considered as a separate entity which differs in almost all skeletal and dental features from Class and Class II/1. A Class II skeletal pattern and reduced interincisal angle were common features of Class II/1 malocclusion, while a Class II skeletal pattern, increased interincisal angle, and skeletal deep bite were common features of Class 11/2 malocclusion.

**Ali H. Hassan (2010)<sup>[32]</sup>** The objective of the study was to describe and analyzed the cephalometric dento-skeletal characteristics associated with Angle's Class II, division 1 malocclusion in Saudi population living in the western region. The subjects included 149 lateral cephalogram comprising two series: (1) 85 films of children with Class II, division malocclusion and (2) 62 films of children with "normal" occlusion. Age range of the representing children was 10-13 years. The result showed that maxilla was prognathic in relation to anterior cranial base. Whereas the mandible. was normally positioned in relation to anterior cranial base. Upper incisors were proclined and lower incisors were normally positioned. The cranial base angle was not different between the two groups. In the western region of Saudi Arabia had Class II division I malocclusion with prognathic maxilla, indicating the use of head gear therapy.

**Derech ADC, Locks A, Janeiro DRBMA, Janeiro DR (2010)<sup>[33]</sup>** The purpose of this study was to evaluate palatal contours in nonextraction orthodontic treatment and long-term stability in patients with Class II Division 1 malocclusions. Data were obtained from maxillary study models before treatment, after treatment, and at least 5 years postretention. During treatment, the canine region was stable; in the premolar and molar regions, there were statistically significant increases in transverse (palatal and base widths) and palatal height measurements, whereas the alveolar angle decreased. The study concluded that a favorable transverse gain of the palatal base, from growth or orthodontics, was important for stability.

**Mahmod KJ, Hamdy KA, Hazem IM (2011)<sup>[34]</sup>** This study was to evaluate and compare dental arch and alveolar widths of patients with Class II division one malocclusion with group of untreated normal occlusion subjects. This study was performed using measurement on dental casts of 30 normal occlusion and 30 Class II division 1 malocclusion of Iraqi sample aged 15-22 years. Maxillary molar teeth in subjects with Class II division 1 malocclusion tend to incline to the buccal to

compensate the insufficient alveolar base therefore rapid maxillary expansion rather than slow maxillary expansion should be considered during treatment of Class II division 1 patients. The results of our study suggested that transverse discrepancy in Class II division one malocclusion originated from upper posterior teeth and maxillary alveolar base.

**Dhakar J, Kantipur (2011)**<sup>[35]</sup> The objective of the study was to perform the dentoskeletal characteristics of Class II malocclusion subjects were evaluated using cephalometric radiograph and dental cast of 60 untreated patients. The sample included 30 Class II Division 1 and 30 Class II Division 2 malocclusion patients. The result showed statistically significant difference between the groups for mandibular inter-canine width only. The cephalometric analysis revealed that SNB angle was responsible for the skeletal sagittal difference between the two groups except for the position of maxillary incisors. No basic difference in dentoskeletal morphology existed between Class II Division 1 and Class II Division 2 malocclusions.

**Perillo L, Padricelli G, Isola G, Femiano F(2012)**<sup>[37]</sup> The purpose of this study was to analyse the craniofacial and dentofacial skeletal characteristics in untreated subjects with Class II, division malocclusion by mandibular retrusion and to identify different type and their prevalence In 152 subjects with Class II, Division 1 malocclusion by mandibular retrusion, the differences were determined by lateral cephalograms analysis of variance and chi-square test, respectively . All patients showed significant inter-group differences . The pure positional type presented the flattest cranial base, high AOBO, In the mixed types, dento-skeletal features changed depending on how the main types assorted. Identifying the type of mandibular retrusion is important for differential diagnosis in clinical practice and research.

**Oliveira DVM (2012)**<sup>[37]</sup> This article relates the treatment of a female African-Brazilian patient, with 20 years and 7 months of age, who presented Angle's Class II, Division 1 malocclusion, AOB, accentuated overjet, lingual interposition during swallowing and difficulty with pronouncing some phonemes. Orthodontic treatment began by mounting an Edgewise Standard fixed appliance system, with a fixed palatal crib appliance and extraction of maxillary first premolars. This case was presented to the Brazilian Board of Orthodontics and Facial Orthopedics (BBO), as part of the requisites to become a BBO Diplomate.

**Minich MC, Araújo AE, Behrents GR, ET AL (2013)**<sup>[38]</sup> The purpose of this study was to determine whether Angle Class II subdivision malocclusions have skeletal or

dental asymmetries between the Class II and Class sides. A sample of 54 untreated Angle Class II subdivision patients with pre-treatment photos and cone-beam computed tomography (CBCT) Scans was used. Significant differences were found for 2 skeletal measurements: the position of the maxilla relative to the cranial base, and the mandibular dimension from the mandibular foramen to the mental foramen. Statistically significant. Dental differences were found for the position of the mandibular first molars and canines in relation to the maxilla and the mandible. Significant dental differences were found for the maxillary first molars and canines in relation to the mandible,

**Meloit FAC, Gonçalves CDR, Silva E, Martins LP (2014)<sup>[18]</sup>** The objective of the present study was to use lateral cephalometric radiographs to identify existing skeletal and dentoalveolar morphological alterations in Class I subdivision and to compare them with the existing morphology in Class I and Class II relationship. 19 lateral cephalometric radiographs of male and female Brazilian children aged between 12 to 15 years old were randomly and proportionally divided into three groups: Group 1 (Class I) Group 2 (Class II) and Group 3 (Class II subdivision). Analysis of lateral cephalometric. Radiused angular measurements, horizontal linear measurements and two Endives of asymmetry that were prepared for this study. Results in accordance with an Index of Dental Asymmetry (IDA), greater mandibular dental asymmetry was Identified in Group 3. An Index of Mandibular Asymmetry (IMA) revealed less skeletal and dental.

**Thilagarani, Hamsa R, Abdul Hameed A, Anand S (2014)<sup>[40]</sup>** The aim of the study was to evaluate the most common skeletal discrepancy daily practice study consisted of 60 cephalograms of 30 subjects with normal occlusion and 30 subjects with Angles Class II Division 1 malocclusion of age ranging from 10 to 14 years. The hard tissues were analysed in accordance with Steiner's method. 14 measurements (9 angular and 5 linear) were made. The dentoskeletal abnormality of Angles Class II Division I malocclusion cases had the maxillary base having normal relation to the cranial base whereas mandible was found to be retrognathic in relation to the cranial base being posteriorly positioned. The following study can be concluded with regard to the skeletal abnormality the maxillary base was found to be having normal relation to the cranial base where as mandible was found to be retrognathic in relation to the cranial base by being posteriorly positioned.

**Lira DSLDA, Souza GMM, Bolognese MA, Nojima M (2014)** <sup>[41]</sup> To compare 2 types of treatment for Class II malocclusion assessing mandibular behaviour in Subjects submitted to full orthodontic treatment with standard edgewise appliance and cervical headgear (Kloehn appliance) and those who used cervical headgear in the first period and with full orthodontic appliance in the second period Methods the sample consisted of 80 children treated with either cervical headgear combined with full fixed appliances (n=40, group 1), or with cervical headgear at first (n=40, group 2). In both groups. All patients were treated with no extraction and no use of Class II intermaxillary elastics during the full orthodontic treatment. In both groups, the effective treatment of skeletal Class II malocclusion did not interfere in the direction and amount of growth of mandibular condyles and remodeling at the lower border. with no influence on the anti-clockwise rotation of the mandible. The mandibular growth also was observed after the orthodontic treatment, suggesting that it is influenced by genetic factors. These observations may lead to the speculation that growing patients with skeletal Class II malocclusion and low mandibular plane are conducive to a good treatment and long-term stability with one or two periods of treatment.

**LI J, HE Y, Wang Y, Chen T (2015)** <sup>[19]</sup> The Treatment outcomes of Angle Class II subdivision malocclusions may be compromised because of the uncertainty of the aetiology. This study was a cross-sectional investigation of the characteristics of Angle Class II subdivision malocclusion, including dental, skeletal and functional factors, by comparison of the subdivision group and the normal occlusion group. The evaluations of dental and skeletal asymmetries of both groups were carried out by cone-beam computed tomography (CBCT) and analysis of dental casts. The most important finding was that, in subdivision malocclusions, functional deviation resulting in pseudo asymmetry occurred in 32.86% of the study participants. The origin of Angle Class II subdivision malocclusion is multifactorial, with dental, skeletal and functional factors included. Functional deviation occurs, probably due to dental arch width disharmony. Asymmetric position of the glenoid fossa may account for most of the skeletal asymmetry.

**Maetevorakul S, Viteporn S (2016)** <sup>[42]</sup> The purpose of this study was to investigate the factors influencing the soft tissue profile changes following orthodontic treatment in Class II Division I patients. The subjects comprised 104 Thai patients age 8-16 years who presented Class II Division 1 malocclusions and were treated with different

orthodontic modalities comprising cervical headgear, Class II traction and extraction of the four first premolars. The multiple regression analysis indicated that different treatment modalities, age, sex, pretreatment skeletal, dental and soft tissue morphology were related to the profile changes. age and sex also had mainly affected a change of the soft tissue profile in the vertical direction.

**Prodhan R, Rajbhandart A, Shrestha LS (2016)** <sup>[43]</sup> To determine cephalometric norms using McNamara's analysis in adult Brahmins of Kathmandu and to compare the vales within the group and with Caucasians. Screening of 850 individuals aged 18-27 years was performed, inclusion criteria were Angie's Class malar and canine relation with normal overjet and overbite, symmetric face with acceptable profile, without craniofacial abnormalities, orthodontic/surgical treatment in the past and without proximal caries or prosthesis. Lateral digital cephalometric radiographs at 41 selected adult Prohimins of Kathmandu (23 males and 18 females) were manually traced Comparative test was conducted within adult Brahmins of Kathmandu and with Caucasian group at significance level ( $P=50.05$ ).Adult male Brahmins of Kathmandu were found to have forger craniofacial measurements: Effective Mandibular Length tps0.001), Maxilo-mandibular Differential ( $P=0.05$ ) and Lower Anterior Facial Height (ps0.01) than adult female Brahmins of Kathmandu. Adult Brahmins were found to have smaller craniofacial measurements compared to Caucasians. Gender and ethnic diversity must be considered during orthodontic diagnosis and treatment planning for an Individual.

**Ali FR Rabah, Zacaria HAJ Kheder Mulla ISSA, Firas Haj Kheder (2017)** <sup>[44]</sup> The purpose of this study was to determine the cephalometric norms of typical Arab young adults with class I molar relationship and well-balanced face and to compare these norms with those derived from matched Chinese subjects. Lateral cephalometric of 71 Arab adults (37 males age 20-26) (female age 20-26) were compared with 76 Chinese young adults (42 male age 20-26) (34 female 20-26). Each lateral cephalogram were traced and digitized using cephalometric software program according to Steiner analysis with Advanced maxilla and protruded mandible. The results of this study showed that the Chinese's Maxilla and Mandible were more protruded than Arabs, while Arabs had a higher angle of both the occlusal and mandibular planes.

**Xiong X, Huang Y, Liu W, Wu y yating Y et al (2020)** <sup>[45]</sup> To obtain the distribution of different Maxilla-Mandibular characteristics in Chinese skeletal Class

II mixed dentition patients and to compare the differences of Cephalometric variables among different Maxilla Mandibular types. A cross-sectional study was conducted among 310 skeletal Class II patients in mixed dentition. The patients were divided into 6 groups according to SNA and SNB angle of the cephalogram. A total of 38 cephalometric measurements were measured on their cephalograms. Differences among groups were tested by one-way analysis of variance. Statistical differences were found in 25 cephalometric measurements among the other 4 group. The most common etiology forming skeletal Class II malocclusion in Chinese children was mandibular retrusion which was mainly caused by the small size and hyperdivergent growth direction of Mandible.

**Alshammery AD, Almubarak S, Hezaim BA, Razan AR (2022)** <sup>[46]</sup> The study on cephalometric norms among different Arabic countries, "Caucasian" norms are still used as the standard in these countries. The aim of this study was the topic and show a meta-analysis of the review for the skeletal values observed in the study. An electronic search was conducted for studies that examined the SNA, SNB, and ANB angles in study subjects in different Arabic speaking countries. A total of 16 studies were eligible for inclusion in the systematic review and a meta-analysis with results from these studies was completed using the Open Meta-Analyst software (Brown University, Providence, RI, USA). The weighted mean and for heterogeneity were computed individually for the SNA, SNB, and ANB angles, respectively. The result of the meta-analysis showed a significant heterogeneity for the SNA, SNB, and ANB angles of each of the Populations, suggesting that the populations of the different Arab nations studied were ethnically diverse. Within the limitations of this study, it was concluded that given the high level of heterogeneity it may not be feasible to speak of the different Arabic speaking nations as a distinct population for the purpose of developing norms for cephalometric skeletal relationships.

**James A, Edward Ellis III** <sup>[47]</sup> comprised of Numerous cephalometric analyses have been applied to defined samples of untreated individuals to derive cephalometric "norms" for a given population, usually grouped by age and ethnic origin. The data from such studies can be used cross sectionally for comparison during diagnosis and treatment planning. One hundred twenty-five individuals were examined in this study, and dentofacial norms for males and females with "ideal" occlusal and facial relationships were established. It should be stressed, however, that infinite combinations of dentoskeletal relationships in each patient are possible to arrive at a

face that is well balanced and that has an ideal occlusal relationship. The purpose of establishing cephalometric norms is not to create "targets" for individual treatment, but rather guides for the clinical assessment of the patient. The final diagnosis and treatment plan will rely on a number of other factors that cannot be obtained from a radiograph.

## **MATERIALS AND METHOD**

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences, Lucknow. with an aim to compare the Cephalometric skeletal characteristics of Angle's Class II Division 1 subdivision malocclusion with that of Angle's Class I and Angle's Class II Division I malocclusion. The sample was collected from patient coming to the department for fixed orthodontic treatment in the age range of 12 to 25 years (mean age  $18.5 \pm 6.5$  years). Also, the sample was selected from old records in the department based on molar relationship as seen on study model. The sample included pre-treatment Lateral Cephalograms of 90 subjects, divided in three Groups-Group I included 30 subjects with Class I malocclusion, Group II included 30 subjects with Class II Division 1 malocclusion and Group III included 30 subjects with Class II Division I subdivision malocclusion.

### **SAMPLE SELECTION**

The Sample for the present study was selected based on following criteria.

- **Inclusion criteria:**
  - Patients within age range of 12-25 years.
  - Patients having Class I, Class II Division I Class II Division I Subdivision malocclusion based on molar relationship.
  - Presence of all teeth in both the arches up to second molars.
- **Exclusion criteria.**
  - No history of trauma in maxillofacial region.
  - No history of previous Orthodontic or Ortho-surgical treatment.
  - No congenital defects involving the craniofacial region
  - No history of surgeries in craniofacial region.

### **ETHICAL COMMITTEE APPOROVAL**

Approval was obtained from the Ethical and Research Committee before conducting the study at Babu Banarasi Das College of Dental Sciences, Lucknow, U.P, India. Informed consent was taken from all the subjects as per the format.

**Table 1: Showing distribution of sample into groups and subgroups**

| Group               | Subgroup                                                   | No of Subject | Means Age± SD (In Years) |
|---------------------|------------------------------------------------------------|---------------|--------------------------|
| Group I<br>(N=30)   | Ia Class I malocclusion (Male)                             | 15            | 18.08±2.39 yrs           |
|                     | Ib Class I malocclusion (Female)                           | 15            | 20.47±5.54 yrs           |
| Group II<br>(N=30)  | Ila Class II Division 1 malocclusion (Male )               | 15            | 19.18±3.87 yrs           |
|                     | Ilb Class II Division 1 malocclusion (Female )             | 15            | 18.47±4.09 yrs           |
| Group III<br>(N=30) | IIIa Class II Division 1 Subdivision malocclusion (Male)   | 15            | 19.29±2.81 yrs           |
|                     | IIIb Class II Division 1 Subdivision malocclusion (Female) | 15            | 20.38±4.31 yrs           |

## **Materials and Methods:**

### **ARMAMENTARIUM FOR THE STUDY:**

To conduct the present study, armamentarium used are listed below:

### **MATERIALS USED FOR PREPARING STUDY MODEL:**

Figure 1-3 (A) Base Formar, (B) Spatula, (C) Bowl (D) Dental stone plaster (E) Alginate (F) maxillary and mandibular impression tray

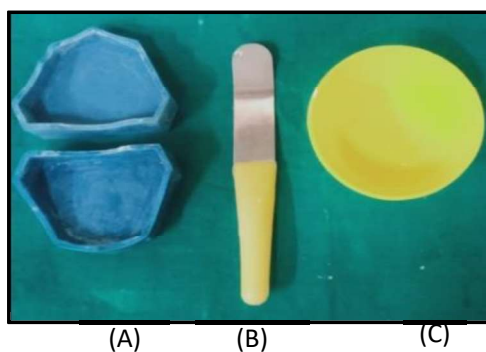


**Figure 1**



**Figure 2**

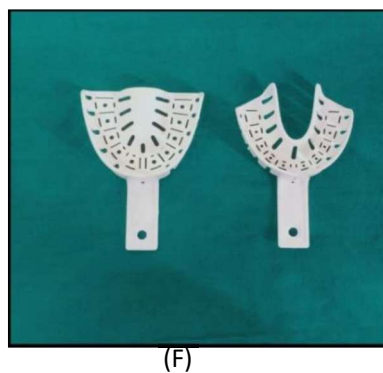


**Figure 3**

**Figure 1-3: Materials used for preparing study model.**

(A) Base Formar, (B) Spatula, (C) Bowl  
(D) Dental stone plaster (E) Alginate, (F) maxillary and mandibular impression tray.

## **METHODOLOGY**

### **METHOD OF PREPARING STUDY MODEL**

A. **Study Model:** Study model for each patient was prepared using standard protocol, molar relationship according to angle's classification was evaluated to divide the sample into Class I, Class II Division I and Class II Division I subdivision malocclusion. Figure 4-6



**Class I Malocclusion**



**Class II Division I Malocclusion**



**Right :** Class II Division I subdivision  
malocclusion



**Left :** Class II Division I subdivision  
malocclusion

**Figure 4: Class II Division I subdivision malocclusion**

**B. Material used for obtaining Lateral Cephalogram:**

1. **Cephalostat Machine:** Planmeca proline XC cephalostat (Finland) machine were used to take digital Lateral Cephalograms of selected subjects. The exposure was set at 68 KV, 5 mA and exposure time of 23 seconds and receptor was placed at a distance of 60 inches. Figure 5



**Figure 5: Cephalostat Machine**

- Soft copy of Lateral Cephalograms:
- Pre - treatment lateral cephalograms of each patient saved in CD-ROM were taken from the record files (Figure 8).

- Nemoceph Software:
- Nemoceph software (Dental studio version 6.0) was used to trace and analyse the Lateral Cephalogram.

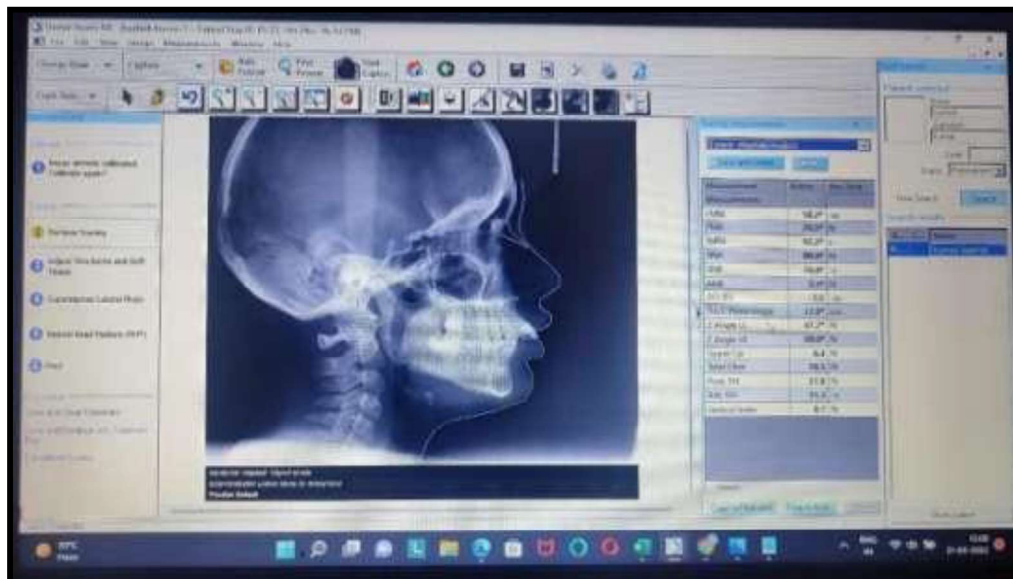


**Figure 6: Pretreatment lateral cephalogram uploaded in Nemoceph Softwar**

## **2. Methods of Taking Radiographs**

A. 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 car posts were used for correct alignment of the patient's head for undistorted symmetrical image of the patient. Relaxed lip was achieved by giving direct instructions to the patient Figure 9. The receptor - source distance was fixed at 60 inches. The exposure values were set at 68kV, 5mA at 23 seconds exposure time. All the cephalograms were transferred to a computer loaded with Planmeca software from where the digital Lateral Cephalograms were saved in bitmap files and taken in a CD ROM



**Figure 7: Subject position while taking of Lateral Cephalogram.**

**B. Transfer of soft copies of lateral cephalogram:**

Pre-treatment Lateral Cephalograms were taken and transferred to a computer loaded with Planmeca software, from where the digital Lateral Cephalograms were saved as bitmap files and taken in CD ROM for further evaluation.

**C. Calibration of images:**

The soft copies of all the lateral cephalograms were transferred to Nemotech software program (Dental studio-NX, version 6.0). The images were calibrated by identifying two crosshairs - 10 mm apart on Lateral Cephalogram to eliminate magnification error.

**D. Identification of landmarks:**

The image enhancement feature of the software (basic and advanced cephalometric tools), like brightness, contrast adjustment and magnification were used to identify individual cephalometric landmarks as precisely as possible. The landmarks were marked with the help of mouse/cursor.

**CEPHALOMETRIC POINTS AND LANDMARKS USED IN THE STUDY:**

The following soft tissue, hard tissue landmarks and reference lines / planes were used for the study.

**A. Hard tissue landmarks Figure 10:**

1. Sella (S): Center of the of Sella Turica.
2. Nasion (N): Most anterior point of the Nasofrontal suture in the midsagittal plane.
3. Orbitale (Or): Lowest most point on the inferior rim of the orbit.
4. Porion (Po): Most superiorly positioned point of the external auditory meatus.
5. Point A: Deepest point in the midsagittal plane between the Anterior Nasal Spine and Prosthion.
6. Point B: Deepest point in the midsagittal plane between Infradentale and Pogonion.
7. Pog (Pg): Most anterior point of the bony chin.
8. Gnathion (Gn): Antero-inferior point of bony chin located by taking the midpoint between the anterior (Pogonion) and inferior (Menton) points of the bony chin.
9. Menton (Me): Lowest point on the bony chin.
10. Gonion (Go): A point on the curvature of the angle of the mandible located by bisecting the angle formed by lines tangent to the posterior ramus and the inferior border of the mandible.
11. ANS: Anterior tip of the nasal spine.
12. PNS: A point at the most posterior aspect of the palatine bone.
13. Condylion (Cd): The most superior most point on the condylar head of the mandible.
14. Ptm: Apex of the teardrop shaped pterygomaxillary fissure.

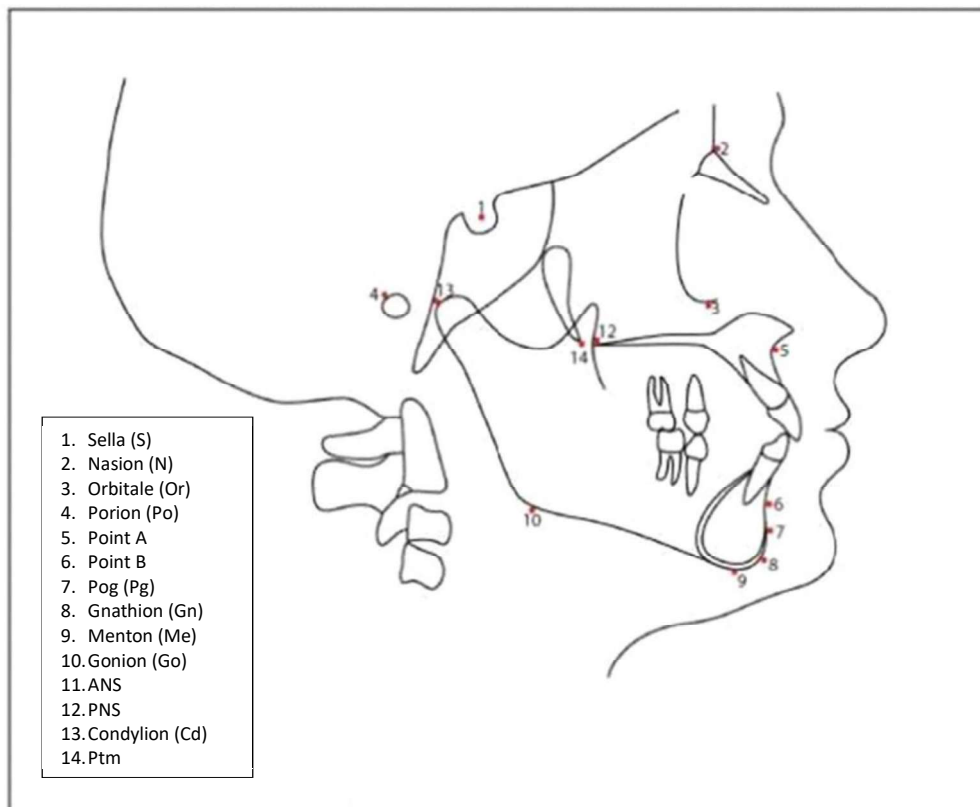


**Figure 8: Hard tissue landmarks used in the study**

|                  |                  |                    |
|------------------|------------------|--------------------|
| 1.Sella(S)       | 6.Point B        | 11. ANS            |
| 2. Nasion(N)     | 7. Pog (Pg)      | 12. PNS            |
| 3. Orbitale (Or) | 8. Gnathion (Gn) | 13. Condylion (Cd) |
| 4. Porion (Po)   | 9. Menton (Me)   | 14. Ptm            |
| 5. Point A       | 10. Gonion (Go)  |                    |

Soft tissue landmarks Figure: 10

1. Subnasale (Sn): The point at which the columella (nasal septum) merges with the upper lip in the midsagittal plane.
2. Labrale superius (Ls): The most inferior point on the convexity of the upper lip.
3. Labrale inferius (Li): The most anterior point on the convexity of the lower lip.
4. Glabella (G'): The most prominent soft tissue points of the forehead.
5. Soft tissue nasion (N'): The point in the midline of the nasale root at the nasofrontal suture.
6. Soft-tissue pogonion (Pg'): The most anterior point on the soft tissue chin in the mid- sagittal plane.
7. Soft tissue Gnathion (Gn'): A point located by taking the midpoint between the anterior (Pogonion) and inferior (Menton) points of the soft tissue chin.

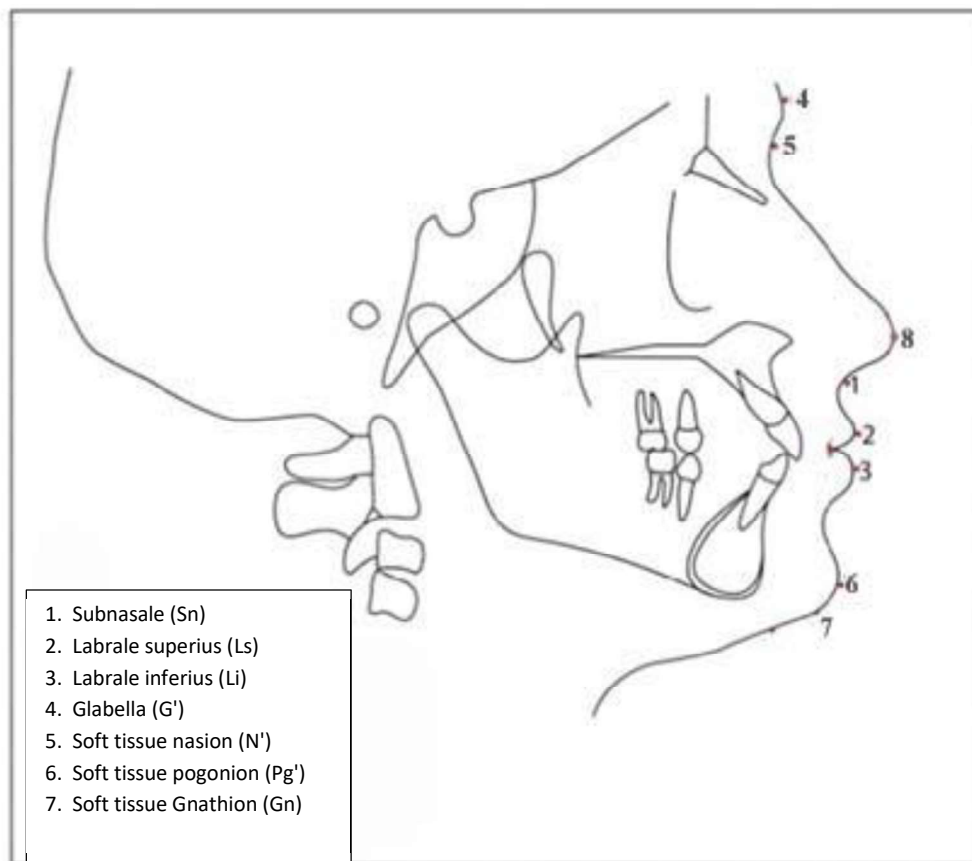


**Figure 9: Soft tissue landmarks used in the study**

- |                           |                                 |
|---------------------------|---------------------------------|
| 1 . Subnasale (Sn)        | 5. Soft -tissue nasion (N')     |
| 2 . Labrale superius (Ls) | 6. Soft - tissue pogonion (Pg') |
| 3. Labrale inferius (Li)  | 7. Soft tissue Gnathion (Gn')   |
| 4. Glabella (G')          |                                 |

**REFERENCE LINES / PLANES USED IN THE STUDY Figure : 12**

1. SN Plane – Linear plane drawn from Sella to Nasion.
2. True HP-A horizontal plane is drawn at 7 degree from SN plane from Sella.
3. FH Plane – Linear plane drawn from Porion to Orbitale.
4. Md Plane – Linear plane drawn from Go to Gn.
5. Functional OP Plane – A Line drawn bisecting overlapping cusps of the first premolars and first molars.
6. B line (Sn- Pg') A line drawn from soft tissue subnasale (Sn) to soft tissue pogonion (Pog')

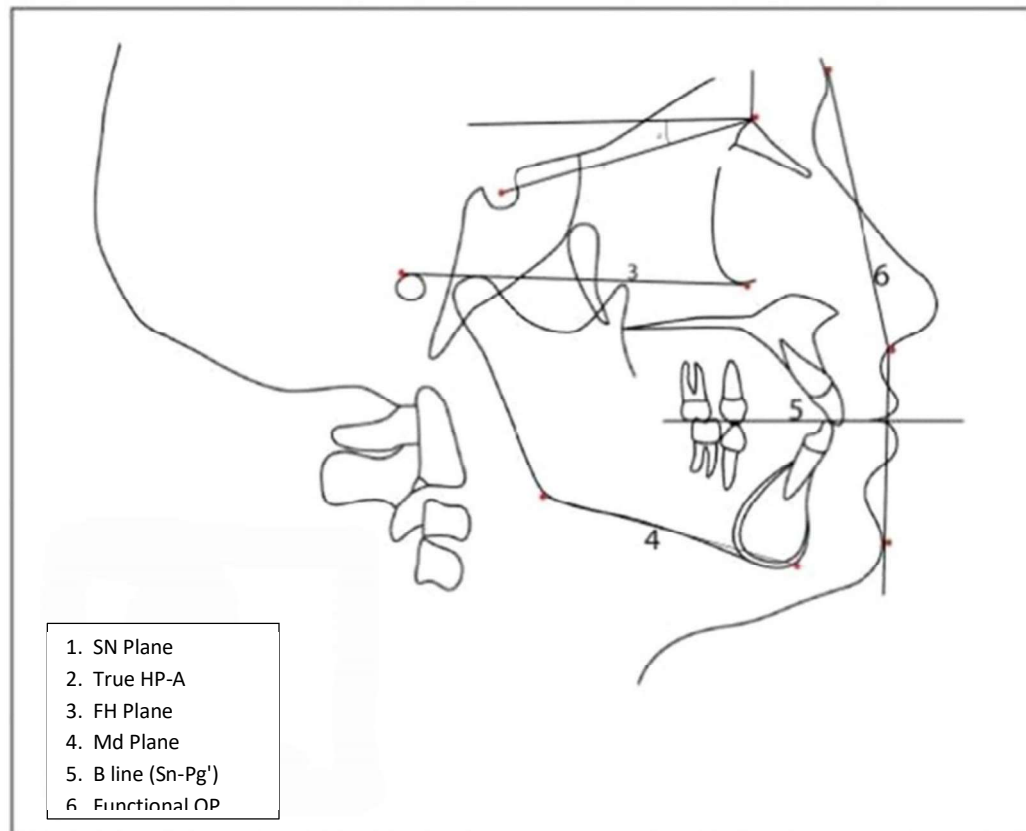


**Figure 10: Reference Line and plains used in study**

- |              |                        |
|--------------|------------------------|
| 1. SN Plane  | 4. Md Plane            |
| 2. True HP-A | 5. B line (Sn-Pg')     |
| 3. FH Plane  | 6. Functional OP Plane |

## **PARAMETERS USED IN THE STUDY**

Following skeletal, dental and soft tissue parameter were used in present study

### **A. Skeletal Parameter Fig No : 11**

1. Mandibular Plane Angle -The mandibular plane angle is an angle measured between Md plane (Go- Gn) and SN plane.
2. SNA- The angle formed between SN plane and line drawn from Nasion to point A.
3. SNB- The angle formed between SN plane and line drawn from Nasion to point B.
4. ANB- Anteroposterior relationship between A-point and B-point with respect to nasion.
5. N-perpendicular to point A - A perpendicular to HP is dropped from N (N perpendicular) and horizontal distance parallel to HP is measured from point A to N perpendicular to B.
6. N-perpendicular to point B – The horizontal distance between Point B and Nasion perpendicular (N perpendicular),measured parallal to HP.
7. Effective Maxillary length (Co-point A)- Effective Midfacial length is measured from condylion to point A.
8. Effective Mandibular Length (Co-Gn)- Effective Mandibular length is measured from condylion to Gnathion.
9. Mx-Mn difference- Difference between effective maxillary and mandibular length
10. Max Length (ANS-PNS)- Distance between these two points on HP gives us total maxillary length.
11. Mn length-Linear measurement from Gonion to Pogonion
12. Ptm-PNS- Linear distance between perpendicular drawn from Ptm to ANS-PNS plane and point PNS

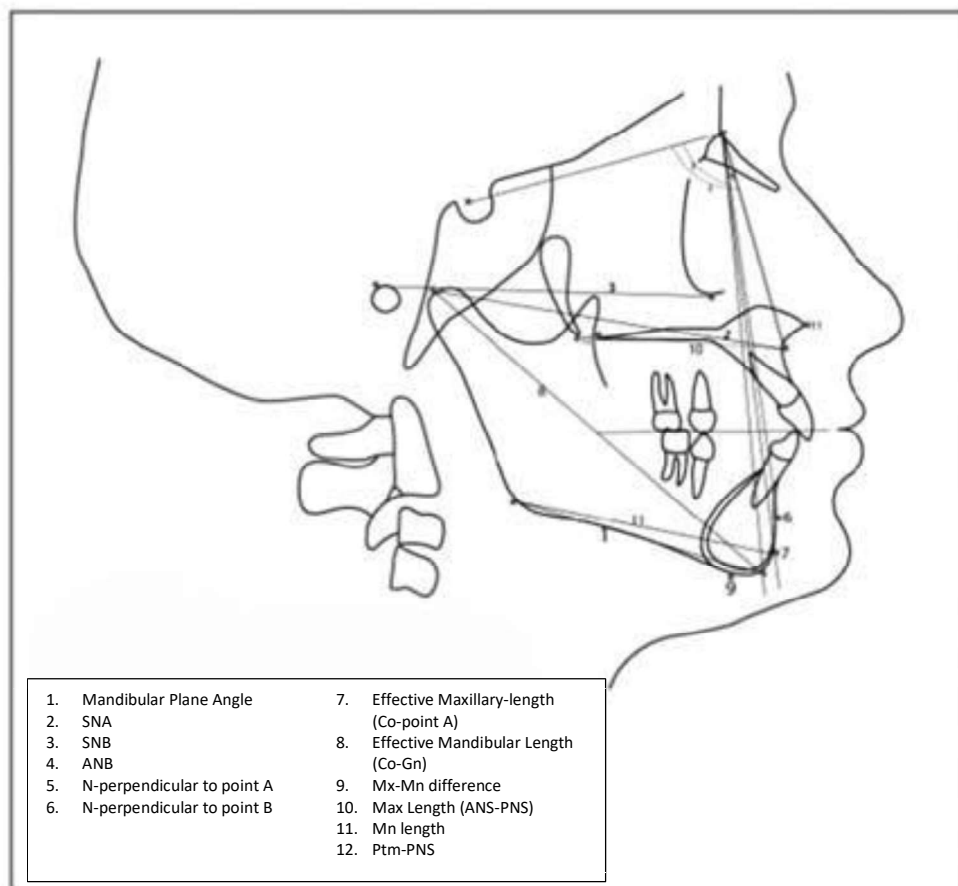


**Figure 11: Skeletal Parameters used in the study**

- |                               |                                             |               |
|-------------------------------|---------------------------------------------|---------------|
| 1. Mandibular Plane Angle     | 6. N-perpendicular to point B               | 11. Mn length |
| 2. SNA                        | 7. Effective Maxillary -length (Co-point A) | 12. Ptm-PNS   |
| 3. SNB                        | 8. Effective Mandibular Length (Co-Gn)      |               |
| 4. ANB                        | 9. Mx-Mn difference                         |               |
| 5. N-perpendicular to point A | 10. Max Length (ANS-PNS)                    |               |

**Dental Parameter Figure :12**

1. Maxillary Incisor Position:
  - a. Upper 1 to NA(angle) - Angle measured between long axis of Maxillary Incisor to line drawn from Nasion to point A
  - b. Upper 1 to NA( mm)-Linear distance measured from anterior point of maxillary 1 to line drawn from Nasion to Point A.
2. Mandibular Incisor Position-
  - a. Lower 1 to NB (angle): the angle measured between long axis of mandibular incisor to line drawn from nasion to point B.
  - b. Lower1 to NB( mm): Linear distance measured from anterior point of mandibular incisor to line drawn from nasion to point B.
3. AB II OP- The distance between perpendicular projection of Point A and Point B onfunctional occlusal plane.

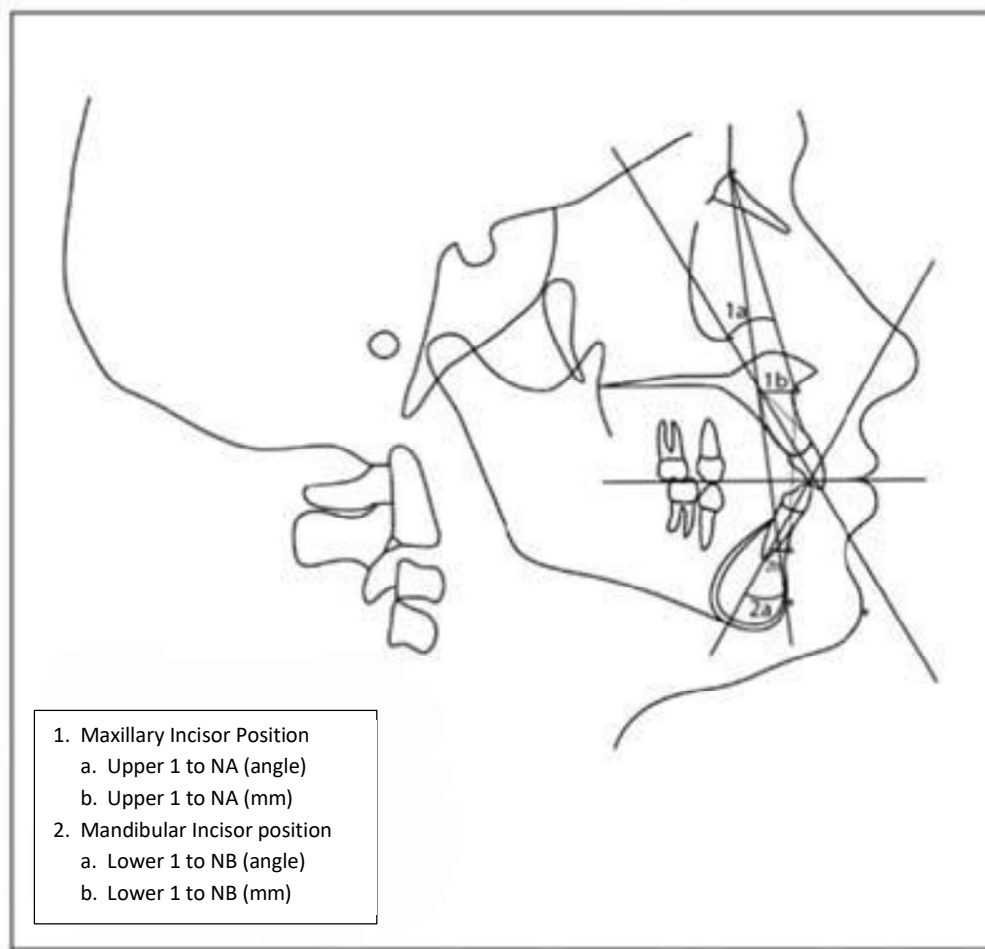


**Figure 12: Dental parameters used in the study**

- |                               |                                |
|-------------------------------|--------------------------------|
| 1. Maxillary Incisor Position | 2. Mandibular Incisor position |
| a. Upper 1 to NA (angle)      | a. Lower 1 to NB (angle)       |
| b. Upper 1 to NA (mm)         | b. Lower 1 to NB (mm)          |

**Soft tissue parameters Figure :13-14**

1. Nasolabial Angle- An angle formed between tangent to upper lip and base of nose passing through subnasle. Figure 13
2. Upper Lip Protrusion – Linear distance of anterior most point of upper lip (Ls) to B line (Sn- Pg'). Figure 14
3. Lower Lip Protrusion- Linear distance from anterior most point of lower lip (Li) to B line (Sn – Pg'). Figure 14
4. Facial Convexity (G-Sn- Pg) – Angle formed between lines drawn from Glabella 'G' to Sub nasale 'Sn' and a Sn to soft tissue pogonion .Figure 14
5. Z-Angle - Angle formed between FH plane and line passing through anterior point of most protruded lip and soft tissue pogonion (pg). Figure 14

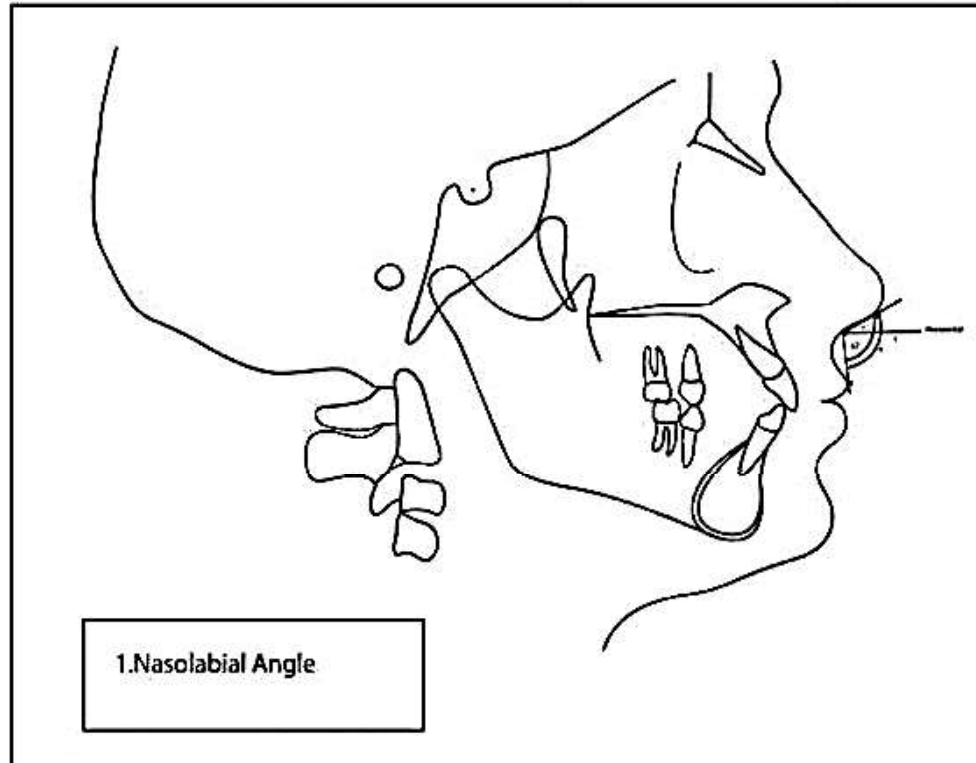


**Figure13: Soft tissue parameter used in the study**

1. Nasolabial Angle

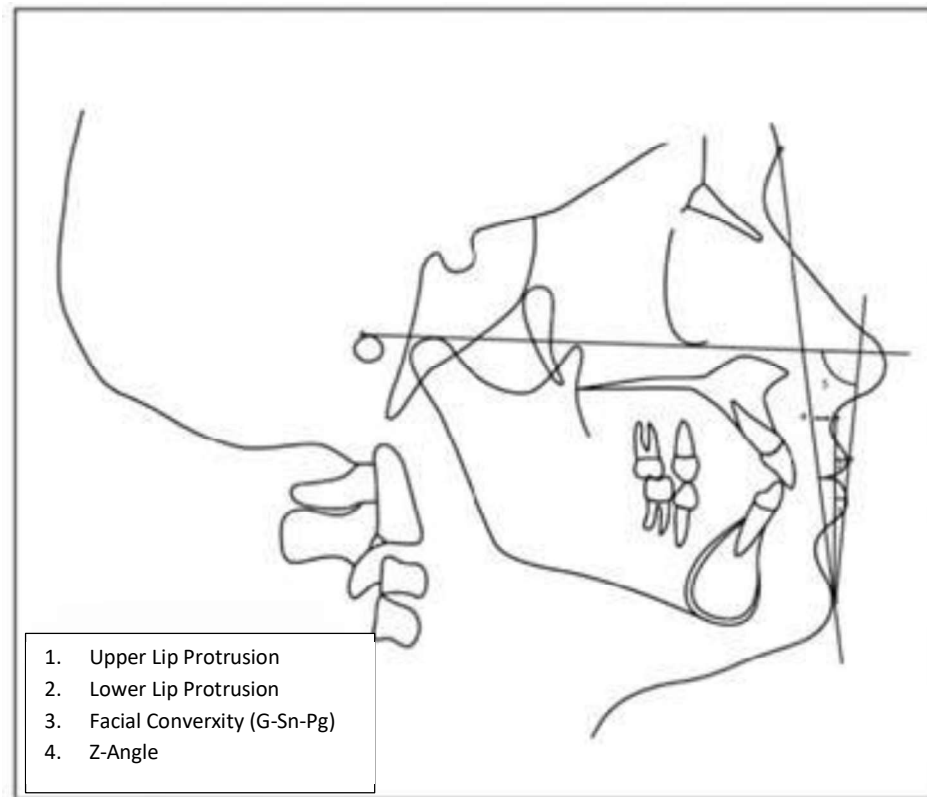


**Figure14: Soft tissue parameters used in the study**

1. Upper Lip Protrusion
2. Lower Lip Protrusion
3. Facial Convexity (G-Sn-Pg)
4. Z-Angle

## MEASUREMENT OF RELIABILITY

Table 2: Reliability Analysis

| Parameter               | Observer 1 |       | Observer 2 |       | Mean<br>diff | paired t test |         |
|-------------------------|------------|-------|------------|-------|--------------|---------------|---------|
|                         | Mean       | SD    | Mean       | SD    |              | t-value       | p-value |
| Mand plane              | 37.88      | 7.86  | 38.18      | 8.56  | -0.30        | -0.60         | 0.582   |
| ANB                     | 6.84       | 1.65  | 6.82       | 2.05  | 0.02         | 0.08          | 0.941   |
| SNA                     | 83.10      | 7.15  | 81.74      | 3.11  | 1.36         | 0.64          | 0.556   |
| SNB                     | 74.28      | 4.57  | 74.36      | 5.10  | -0.08        | -0.24         | 0.824   |
| Co-A                    | 71.72      | 11.92 | 72.10      | 10.51 | -0.38        | -0.54         | 0.621   |
| Co-Gn                   | 90.58      | 14.94 | 91.44      | 15.04 | -0.86        | -2.17         | 0.096   |
| N prep A                | 0.56       | 3.36  | 1.98       | 4.64  | -1.42        | -0.86         | 0.439   |
| N prep B                | -6.74      | 7.29  | -7.40      | 6.84  | 0.66         | 2.38          | 0.076   |
| PTM to PNS              | -41.02     | 6.49  | -25.58     | 39.22 | -15.44       | -0.87         | 0.433   |
| Mx Length               | 43.04      | 7.15  | 44.08      | 7.13  | -1.04        | -1.45         | 0.221   |
| Mn length               | 55.90      | 9.93  | 56.22      | 10.79 | -0.32        | -0.75         | 0.495   |
| Max Man-diff            | 8.88       | 4.17  | 12.18      | 4.95  | -3.30        | -1.35         | 0.248   |
| AB II OP                | 1.98       | 3.16  | 3.42       | 1.50  | -1.44        | -1.30         | 0.262   |
| U1-N                    | 18.54      | 15.86 | 23.06      | 13.00 | -4.52        | -1.17         | 0.308   |
| U1-NA                   | 5.48       | 3.38  | 5.82       | 3.42  | -0.34        | -0.18         | 0.864   |
| L1 – NB                 | 51.32      | 41.48 | 34.66      | 6.62  | 16.66        | 0.97          | 0.389   |
| L1 - NB                 | 8.60       | 2.83  | 8.82       | 2.73  | -0.22        | -1.31         | 0.262   |
| Upper lip<br>Protrusion | 5.64       | 1.37  | 6.42       | 1.88  | -0.78        | -0.61         | 0.574   |
| Lower lip<br>Protrusion | -3.02      | 3.87  | -3.66      | 4.44  | 0.64         | 1.66          | 0.172   |
| Nasolabial angle        | 103.92     | 11.15 | 106.94     | 11.58 | -3.02        | -0.86         | 0.440   |
| Facial<br>Convexiyy     | 20.18      | 6.28  | 22.26      | 6.96  | -2.08        | -0.98         | 0.382   |
| Z angle                 | 60.26      | 7.51  | 58.80      | 8.84  | 1.46         | 0.49          | 0.650   |

Inter-observer reliability was assessed for various parameters measured by two different observers, labelled as Observer 1 and Observer 2. The parameters included measurements related to mandibular and maxillary planes, angular and linear dimensions, as well as facial soft tissue characteristics.

For parameters such as Mand plane, ANB angle, SNA angle, SNB angle, Co-A, Co-Gn, N prep A, N prep B, PTM to PNS, Mx Length, Mn Length, Max Man-diff, AB II OP, U1-N, Upper lip Protrusion, Lower lip Protrusion, Nasolabial angle, Facial Convexity, and Z angle, the mean differences between Observer 1 and Observer 2 were analyzed along with their respective standard deviations.

The mean differences for most parameters were minimal, suggesting overall agreement between the two observers. Paired t-tests were conducted to further assess the statistical significance of these differences. In most cases, the t-values were close to zero, indicating no significant difference between the observers for the measured parameters. Additionally, the p-values were above the conventional threshold of 0.05, further supporting the absence of statistically significant differences between the observers.

Overall, these findings indicate good inter-observer reliability for the majority of the measured parameters, with minimal differences between observers.

## OBSERVATION AND RESULT

**Table 3: Descriptive Statistics Overall Sample for Skeletal Dental and Soft Tissue Parameters of Group I (Class I Malocclusion)**

| S.No.                  | PARAMETER                         | MEAN $\pm$ Std.Deviation | Std.Error | Minimum | Maximum |
|------------------------|-----------------------------------|--------------------------|-----------|---------|---------|
| SKELETAL PARAMETERS    |                                   |                          |           |         |         |
| 1                      | SNA (in $^{\circ}$ )              | 81.773 $\pm$ 3.4505      | .6300     | 73.6    | 87.8    |
| 2                      | SNB (in $^{\circ}$ )              | 78.943 $\pm$ 3.9448      | .7202     | 70.1    | 86.7    |
| 3                      | ANB (in $^{\circ}$ )              | 2.793 $\pm$ .8913        | .1627     | 1.1     | 4.0     |
| 4                      | N perpendicular to point A(in mm) | 1.8167 $\pm$ 3.21999     | .58789    | -3.50   | 7.90    |
| 5                      | N perpendicular to point B(in mm) | 1.173 $\pm$ 4.5596       | .8325     | -9.2    | 7.8     |
| 6                      | Co- A (in mm)                     | 78.000 $\pm$ 14.4362     | 2.6357    | 37.5    | 122.9   |
| 7                      | Co- Gn (in mm)                    | 100.827 $\pm$ 14.9867    | 2.7362    | 79.1    | 152.3   |
| 8                      | Mx-Mand diff (in mm)              | 21.727 $\pm$ 4.1066      | .7498     | 13.5    | 29.4    |
| 9                      | Mx Length (in mm)                 | 48.300 $\pm$ 8.6538      | 1.5800    | 30.8    | 77.0    |
| 10                     | Mand Length (in mm)               | 67.177 $\pm$ 12.2425     | 2.2352    | 52.3    | 117.1   |
| 11                     | Mand Plane (in $^{\circ}$ )       | 31.940 $\pm$ 5.2915      | .9661     | 22.4    | 47.0    |
| DENTAL PARAMETERS      |                                   |                          |           |         |         |
| 12                     | U1 -NA (in $^{\circ}$ )           | 30.820 $\pm$ 6.8606      | 1.2526    | 20.1    | 44.3    |
| 13                     | U1-NA (in mm)                     | 7.737 $\pm$ 3.4490       | .6297     | 1.9     | 16.0    |
| 14                     | L1to NB (in $^{\circ}$ )          | 32.617 $\pm$ 9.3776      | 1.7121    | 14.7    | 52.7    |
| 15                     | L1 -NB (in mm)                    | 7.380 $\pm$ 3.4412       | .6283     | .8      | 14.0    |
| 16                     | AB II OP (in mm)                  | 4.870 $\pm$ 3.8848       | .7093     | .3      | 18.4    |
| SOFT TISSUE PARAMETERS |                                   |                          |           |         |         |
| 17                     | Upper lip Protrusion (in mm)      | 5.583 $\pm$ 1.9074       | .3482     | 1.6     | 9.3     |
| 18                     | Lower lip protrusion (in mm)      | 5.067 $\pm$ 3.4945       | .6380     | -12.9   | 2.5     |
| 19                     | Nasolabial angle (in $^{\circ}$ ) | 103.260 $\pm$ 7.6432     | 1.3955    | 92.0    | 119.1   |
| 20                     | Facial convexity (in $^{\circ}$ ) | 17.787 $\pm$ 5.7230      | 1.0449    | 8.3     | 31.6    |
| 21                     | Z angle upperlip (in $^{\circ}$ ) | 68.003 $\pm$ 8.0720      | 1.4737    | 50.3    | 82.1    |
| 22                     | Z angle Lowerlip (in $^{\circ}$ ) | 64.423 $\pm$ 9.1692      | 1.6741    | 40.9    | 83.7    |

**Table 4: Descriptive Statistics for Skeletal, Dental, and Soft tissue Overall Sample of Group II (Class II Division 1- Malocclusion)**

| S.No.                  | PARAMETER                    | MEAN $\pm$ Std. Division | Std.Err. | Minimum | Maximum |
|------------------------|------------------------------|--------------------------|----------|---------|---------|
| SKELETAL PARAMETERS    |                              |                          |          |         |         |
| 1                      | SNA (in°)                    | 84.653 $\pm$ 3.3143      | .6051    | 79.0    | 93.2    |
| 2                      | SNB (in°)                    | 78.907 $\pm$ 3.7370      | .6823    | 72.7    | 89.8    |
| 3                      | ANB (in°)                    | 5.623 $\pm$ 1.4787       | .2700    | .6      | 8.7     |
| 4                      | N perpendicular A (in°)      | 2.7367 $\pm$ 2.25335     | .41140   | -1.60   | 8.60    |
| 5                      | N perpendicular B (in°)      | 3.773 $\pm$ 4.2739       | .7803    | -11.8   | 2.6     |
| 6                      | Co- A (in mm)                | 79.163 $\pm$ 7.8112      | 1.4261   | 63.0    | 96.0    |
| 7                      | Co- Gn (in mm)               | 99.287 $\pm$ 10.0431     | 1.8336   | 78.0    | 114.2   |
| 8                      | Mx-Mand diff (in mm)         | 20.207 $\pm$ 4.9709      | .9076    | 11.3    | 33.1    |
| 9                      | Mx Length (in mm)            | 48.180 $\pm$ 4.6863      | .8556    | 37.0    | 58.1    |
| 10                     | Mand Length (in mm)          | 65.273 $\pm$ 8.2713      | 1.5101   | 53.5    | 88.9    |
| 11                     | Mand Plane (in°)             | 30.800 $\pm$ 5.3382      | .9746    | 24.2    | 41.4    |
| DENTAL PARAMETERS      |                              |                          |          |         |         |
| 12                     | U1 –NA (in°)                 | 30.917 $\pm$ 5.4048      | .9868    | 21.6    | 40.1    |
| 13                     | U1-NA (in mm)                | 7.197 $\pm$ 2.9911       | .5461    | 1.1     | 12.5    |
| 14                     | L1to NB (in°)                | 28.030 $\pm$ 4.1648      | .7604    | 17.7    | 34.2    |
| 15                     | L1 -NB (in mm)               | 6.517 $\pm$ 1.7440       | .3184    | 4.1     | 10.0    |
| 16                     | AB II OP (in mm)             | 3.857 $\pm$ 2.8216       | .5151    | .1      | 10.9    |
| SOFT TISSUE PARAMETERS |                              |                          |          |         |         |
| 17                     | Upper lip Protrusion (in mm) | 6.167 $\pm$ 1.8087       | .3302    | 1.2     | 9.5     |
| 18                     | Lower lip protrusion (in mm) | 4.310 $\pm$ 3.5291       | .6443    | -9.5    | 8.5     |
| 19                     | Nasolabial angle (in°)       | 96.697 $\pm$ 9.8057      | 1.7903   | 80.7    | 120.3   |
| 20                     | Facial convexity (in°)       | 19.733 $\pm$ 4.8191      | .8798    | 11.3    | 27.5    |
| 21                     | Z angle upperlip (in°)       | 67.950 $\pm$ 6.7425      | 1.2310   | 58.4    | 86.1    |
| 22                     | Z angle Lowerlip (in°)       | 64.983 $\pm$ 9.2228      | 1.6839   | 53.0    | 85.5    |

**Table 5: Descriptive Statistics for Skeletal Dental and soft tissue Overall Sample of Group III (Class II Division 1 Subdivision Malocclusion)**

| S.No.                         | PARAMETER                    | MEAN±Std. Deviation | Std. Error | Minimum | Maximum |
|-------------------------------|------------------------------|---------------------|------------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                              |                     |            |         |         |
| 1.                            | SNA (in°)                    | 82.927±4.3640       | .7968      | 74.6    | 91.9    |
| 2.                            | SNB (in°)                    | 77.447±4.2381       | .7738      | 70.3    | 89.3    |
| 3.                            | ANB (in°)                    | 5.533±1.5586        | .2846      | 4.1     | 10.4    |
| 4.                            | N perpendicular A (in°)      | 2.7123±3.36884      | .61506     | -4.30   | 11.70   |
| 5.                            | N perpendicular B (in°)      | 3.410±4.8378        | 0.8833     | -15.9   | 8.0     |
| 6.                            | Co- A (in mm)                | 78.840±9.4785       | 1.7305     | 59.3    | 65.1    |
| 7.                            | Co- Gn (in mm)               | 97.663±12.0456      | 32.1992    | 68.4    | 118.7   |
| 8.                            | Mx-Mand diff (in mm)         | 19.560±4.8297       | .8818      | 8.9     | 28.5    |
| 9.                            | Mx Length (in mm)            | 48.410±8.2493       | 1.5061     | 32.3    | 62.7    |
| 10.                           | Mand Length (in mm)          | 62.867±8.5067       | 1.5531     | 47.5    | 83.6    |
| 11.                           | Mand Plane (in°)             | 29.780±5.7700       | 1.0534     | 21.3    | 42.3    |
| <b>DENTAL PARAMETERS</b>      |                              |                     |            |         |         |
| 12.                           | U1 –NA (in°)                 | 30.333±7.3465       | 1.3413     | 17.0    | 41.9    |
| 13.                           | U1-NA (in mm)                | 7.130±3.0000        | .5477      | 1.5     | 11.3    |
| 14.                           | L1to NB (in°)                | 29.103±5.0740       | .9264      | 21.1    | 44.1    |
| 15.                           | L1 -NB (in mm)               | 6.423±2.3906        | .4365      | 3.0     | 11.5    |
| 16.                           | AB II OP (in mm)             | 2.840±3.3180        | .6058      | -7.2    | 8.5     |
| <b>SOFT TISSUE PARAMETERS</b> |                              |                     |            |         |         |
| 17.                           | Upper lip Protrusion (in mm) | 6.273±1.9102        | .3488      | 2.3     | 9.7     |
| 18.                           | Lower lip protrusion (in mm) | 5.683±2.9152        | .5322      | -11.0   | .0      |
| 19.                           | Nasolabial angle (in°)       | 99.250±9.0607       | 1.6543     | 81.6    | 11.76   |
| 20.                           | Facial convexity (in°)       | 19.927±6.1023       | 1.1141     | 1.1     | 29.7    |
| 21.                           | Z angle upperlip (in°)       | 65.980±7.0124       | 1.2803     | 54.3    | 82.5    |
| 22.                           | Z angle Lowerlip (in°)       | 61.477±10.7993      | 1.9717     | 41.3    | 82.8    |

**Table 6: Comparative Statistics of Skeletal, Dental and Soft Tissue Parameters of overall sample in Group I, II & III**

| Sl No.                | Overall (n=90)               | Group I<br>Class I (n=30) | Group II<br>Class II div 1 (n=30) | Group III<br>Class II<br>Div 1 Subdivision; (n=30) | ANOVA   |
|-----------------------|------------------------------|---------------------------|-----------------------------------|----------------------------------------------------|---------|
|                       |                              | Mean±SD                   | Mean±SD                           | Mean±SD                                            | p-value |
| SKELETAL PARAMETERS   |                              |                           |                                   |                                                    |         |
| 1                     | SNA (in°)                    | 81.773±3.4505             | 84.653±3.3143                     | 82.927±4.3640                                      | 0.014*  |
| 2                     | SNB (in°)                    | 78.943±3.9448             | 78.907±3.7370                     | 77.447±4.2381                                      | 0.257   |
| 3                     | ANB (in°)                    | 2.793±.8913               | 5.623±1.4787                      | 5.533±1.5586                                       | 0.001*  |
| 4                     | N perpendicular A (in°)      | 1.8167±3.2199             | 2.7367±2.5335                     | 2.7123±3.36884                                     | 0.401   |
| 5                     | N perpendicular B (in°)      | 1.173±4.5596              | 3.773±4.2739                      | 3.410±4.8378                                       | .063    |
| 6                     | Co- A (in mm)                | 78.00±14.4362             | 79.163±7.8112                     | 78.840±9.4785                                      | 0.914   |
| 7                     | Co- Gn (in mm)               | 100.827±14.9867           | 99.287±10.431                     | 97.663±12.0456                                     | 0.621   |
| 8                     | Mx-Mand diff (in mm)         | 21.720±4.1066             | 20.207±4.9709                     | 19.560±4.8297                                      | 0.188   |
| 9                     | Mx Length (in mm)            | 48.300±8.6538             | 48.180±4.6863                     | 48.410±8.2493                                      | 0.993   |
| 10                    | Mand Length (in mm)          | 67.177±12.2425            | 65.273±8.2713                     | 62.867±8.5067                                      | 0.241   |
| 11                    | Mand Plane (in°)             | 31.940±5.2915             | 30.800±5.3382                     | 29.780±5.7700                                      | 0.315   |
| DENTAL PARAMETERS     |                              |                           |                                   |                                                    |         |
| 12                    | U1 –NA (in°)                 | 30.820±6.8606             | 30.917±5.40438                    | 30.333±7.3465                                      | 0.935   |
| 13                    | U1-NA (in mm)                | 7.737±3.4490              | 7.197±2.9911                      | 7.130±3.000                                        | 0.717   |
| 14                    | L1to NB (in°)                | 32.617±9.3776             | 28.030±4.1648                     | 29.103±5.0740                                      | 0.023*  |
| 15                    | L1 -NB (in mm)               | 7.380±3.4412              | 6.517±1.7440                      | 6.423±2.3906                                       | 0.302   |
| 16                    | AB II OP (in mm)             | 4.870±3.8848              | 3.857±2.821                       | 2.840±3.3180                                       | 0.071   |
| SOFT TISSUE PARAMTERS |                              |                           |                                   |                                                    |         |
| 17                    | Upper lip Protrusion (in mm) | 5.583±1.9074              | 6.167±1.8087                      | 6.273±1.91.2                                       | 0.313   |
| 18                    | Lower lip protrusion (in mm) | 5.067±3.4945              | 4.310±3.5291                      | 5.683±2.9152                                       | 0.282   |
| 19                    | Nasolabial angle (in°)       | 103.260±7.6432            | 96.697±9.8057                     | 99.250±9.0607                                      | 0.019*  |
| 20                    | Facial convexity (in°)       | 17.787±5.723              | 19.733±4.8191                     | 19.927±6.1023                                      | 0.264   |
| 21                    | Z angle upperlip (in°)       | 68.003±8.0720             | 67.950±6.7425                     | 65.980±7.0124                                      | 0.476   |
| 22                    | Z angle lower lip (in°)      | 64.423±9.1692             | 64.983±9.2228                     | 61.477±10.7993                                     | 0.332   |

**P>.05 Non-Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.**

**Table 6 Shows Comparative Statistics of Skeletal ,Dental and Soft Tissue Parameters in Group I, II &III**

**SKELETAL PARAMETERS**-On comparing SNA angle between groups, it was seen that highest value of ( $84.653^{\circ} \pm 3.3143^{\circ}$ ) was in Group II, followed by Group III ( $82.927^{\circ} \pm 4.3640^{\circ}$ ) and then group I ( $81.773^{\circ} \pm 3.4505^{\circ}$ ). (Group II>III>I) and the difference was statistically significant difference between the groups. (P=0.014).

**SNB** angle showed, highest value of ( $78.943^{\circ} \pm 3.9448^{\circ}$ ) in Group I, followed by Group II ( $78.907^{\circ} \pm 3.7370^{\circ}$ ) and then group III ( $77.447^{\circ} \pm 4.2381^{\circ}$ ), (Group I>II>III) but there was no statistically significant differences between the groups (P=0.257).

**ANB** angle, showed highest Mean value of ( $5.6230^{\circ} \pm 1.4787^{\circ}$ ) was in Group II, followed by Group III ( $5.533^{\circ} \pm 1.5586^{\circ}$ ) and then Group I ( $2.793^{\circ} \pm 0.8913^{\circ}$ ) (Group II>III>I), and the difference was statistically significant between the groups (P=0.001).

On comparing mean values of **N perpendicular to point A in mm**, it was seen that Maxilla was more forwardly positions ( $2.7367 \pm 2.5335$ )mm in Group II, followed by Group III ( $2.7123 \pm 3.36884$ )mm and then group I ( $1.8167 \pm 3.2199$ )mm group (II>III>I) but there was no statistically significant differences between the groups (P=0.401)

On comparing the mean linear distance between point **N perpendicular to point B** in mm ,it was seen that mandible was more forwardly positioned in group II ( $3.773 \pm 4.2739$ )mm followed Group III ( $3.410 \pm 4.8378$  mm) and then group I ( $1.173 \pm 4.5596$ )mm Group (II>III>I) but there was no statistically significant differences between the groups (P=0.063).

**Effective Maxillary length (Co-point A)** was maximum in group II ( $79.163 \pm 7.8112$  mm) followed by Group III ( $78.840 \pm 9.4785$ ) and then group I ( $78.00 \pm 14.4362$ ) Group (II>III>I) but there was no statistically significant difference between the groups (P=.914).

**Effective Mandibular length(Co-Gn)** was highest in group I ( $100.827 \pm 14.9867$ mm) followed by Group II ( $99.287 \pm 10.431$ mm) and then group III ( $97.663 \pm 12.0456$ )mm , (Group I>II>III) but there was no statistically significant difference between the groups . (P=.621).

**Maxillary Mandibular difference** was highest in group I ( $21.720 \pm 4.1066$ mm) followed by Group II ( $20.207 \pm 4.9709$ mm) and then group III ( $19.560 \pm 4.8297$ mm ), (Group I>II>III) but there was no statistically significant difference between the groups . (P=0.188).

The mean value of **maxillary length** between groups was highest in group III ( $48.410 \pm 8.2493$ mm) followed by group I ( $48.300 \pm 8.6538$ mm) and then group II

(48.180±4.6863mm) group(III>I>II) but there was no statistically significant between the groups(P=0.993).

The mean value of **mandible length** between groups was highest in group I (67.177±12.2425mm) followed by group II (65.273±8.2713mm) and then group III(62.867±8.5067mm) ,Group(I>II>III) but there was no statistically significant difference between the Group.(P=.241)

The mean value of **Mn plane angle (S-N to Go- Gn)** between groups,was highest in group I (31.940±5.2915mm) followed by group II (30.800±5.3382mm) and then group III(29.780±5.7700)mm .(I>II>III) but there was no statistically significant difference between the Group.(P=.315)

#### DENTAL PARAMETERS

Angle measured between **long axis of Maxillary Incisor to line drawn Nasion to point A (UI-NA)** was highest in group II (30.917° ± 5.40438°) followed by group I (30.820±6.8606 mm) and then group III (30.333°±7.3465°) Group(I>II>III) but there was no statistically significant differences between the Group.(P=.935)

Linear distance measured from **anterior point of maxillary 1 to line drawn from Nasion to Point A (UI-NA linear)** was highest in group I (7.737± 3.4490 ) mm followed by group II (7.197±2.9911)mm and then group III (7.130±3.000)mm Group(I>II>III) but there was no statistically significant differences between the Group(P=.717)

The angle measured between **long axis of mandibular incisor to line drawn from nasion to point B (L1-NB)** was highest in group I (32.617° ± 9.3776°) followed by group III (29.103°±5.0740°) and then group II (28.030°±4.1648°) Group(I>III>II) but there was no statistically significant differences between the Group.(P=0.023\*)

Linear distance measured from **anterior point of mandibular incisor to line drawn from nasion to point B. (L1-NB Linear)** was highest in group I (7.380± 3.4412 mm) followed by group I I (6.517±1.7440mm) and then group III (6.423±2.3906mm),(I>II>III) but there was no statistically significant differences between the Group (P=.302) .

The distance between perpendicular projection of **Point A and Point B on functional occlusal plane (AB II OP)** was seen highest value of (4.870 ±3.8848mm ) was in Group I, followed by Group II (3.857 ±2.821mm) and then group III (2.840 ±3.3180mm) Group (I>II>III) but there was no statistically significant differences between the groups. (P=0.071).

**SOFT TISSUE PARAMETERS-**

On comparing mean value of **Upper Lip Protusion** between groups, It was seen highest value of ( $6.273 \pm 1.912\text{mm}$ ) was in Group III, followed by Group II ( $6.167 \pm 1.8087\text{mm}$ ) and then group I ( $5.583 \pm 1.9074\text{mm}$ ) Group (III>II>I) but there was no statistically significant differences between the groups. ( $P=0.313$ ).

On comparing **Lower Lip Protrusion** between groups, highest value of ( $5.683 \pm 2.9152\text{mm}$ ) was in Group III, followed by Group II ( $5.067 \pm 3.4945\text{mm}$ ) and then group I ( $4.310 \pm 3.5291\text{mm}$ ) Group (III>II>I) but there was no statistically significant differences between the groups. ( $P=0.282$ ).

The value of **nasolabial angle** between groups, was highest in Group I ( $103.260^\circ \pm 7.6432^\circ$ ) followed by Group III ( $99.250^\circ \pm 9.0607^\circ$ ) and then group II ( $96.697^\circ \pm 9.8057^\circ$ ) Group (I>III>II) but there was statistically significant differences between the groups ( $P=0.019^*$ ).

**Facial convexity** had highest value of ( $19.97^\circ \pm 6.1023^\circ$ ) in Group III, followed by Group II ( $19.733^\circ \pm 4.8191^\circ$ ) and then group I ( $17.787^\circ \pm 5.723^\circ$ ) Group (III>II>I) but there was no statistically significant differences between the groups. ( $P=0.264$ ).

The value of **Z angle upper lip** was highest in Group I ( $68.003^\circ \pm 8.0720^\circ$ ), followed by Group II ( $67.950^\circ \pm 6.7425^\circ$ ) and then group III ( $65.980^\circ \pm 7.0124^\circ$ ) Group (I>II>III) but there was no statistically significant differences between the groups. ( $P=0.476$ ).

The value of **Z angle lower lip** was highest in Group II ( $64.983^\circ \pm 9.2228^\circ$ ), followed by Group I ( $64.423^\circ \pm 9.1692^\circ$ ) and then group III ( $61.477^\circ \pm 10.7993^\circ$ ) Group (II>I>III) but there was no statistically significant differences between the groups. ( $P=0.332$ ).

**Table 7: Overall Intergroup Comparison of Skeletal, Dental and Soft Tissue parameters among Group I, II, & III.**

| S. No                  | PARAMETERS                         | Group I Vs Group II |           |         | Group I Vs Group III |           |         | Group II Vs Group III |           |         |
|------------------------|------------------------------------|---------------------|-----------|---------|----------------------|-----------|---------|-----------------------|-----------|---------|
|                        |                                    | Mean diff           | Std error | P value | Mean diff            | Std error | P value | Mean diff             | Std error | P value |
| SKELETAL PARAMETERS    |                                    |                     |           |         |                      |           |         |                       |           |         |
| 1                      | SNA (in°)                          | 2.8800*             | .9654     | .010    | 1.7267               | .9654     | .179    | 1.1533                | .9654     | .459    |
| 2                      | SNB (in°)                          | .0367               | 1.0273    | .999    | 1.4967               | 1.0273    | .335    | 1.4967                | 1.02      | .317    |
| 3                      | ANB (in°)                          | .335                | .335      | .335    | .0900                | .3467     | .964    | -2.7400*              | .3467     | .000    |
| 4                      | N perpendicular to point A (in mm) | .92000              | .77165    | .461    | .02433               | .77165    | .999    | -.89567               | .77165    | .480    |
| 5                      | N perpendicular to point B (in mm) | 2.6000              | 1.1781    | .076    | .3633                | 1.1781    | .949    | 2.2367                | 1.1781    | .145    |
| 6                      | Co- A (in mm)                      | 1.1633              | 2.8255    | .911    | .3633                | 1.1781    | .949    | .8400                 | 2.8255    | .952    |
| 7                      | Co- Gn (in mm)                     | 1.5400              | 3.2337    | .883    | 1.6233               | 3.2337    | .871    | 3.1633                | 3.2337    | .593    |
| 8                      | Mx-Mand diff (in mm)               | 1.5133              | 1.2009    | .421    | .6467                | 1.2009    | .853    | 2.1600                | 1.2009    | .176    |
| 9                      | Mx Length (in mm)                  | .1200               | 1.9143    | .998    | .2300                | 1.9143    | .992    | .1100                 | 1.9143    | .998    |
| 10                     | Mand Length (in mm)                | 1.9033              | 2.5415    | .735    | 2.4067               | 2.5415    | .612    | 4.3100                | 2.5415    | .213    |
| 11                     | Mand Plane (in°)                   | 1.1400              | 1.4126    | .700    | 1.0200               | 1.4126    | .751    | 2.1600                | 1.4126    | .282    |
| DENTAL PARAMETERS      |                                    |                     |           |         |                      |           |         |                       |           |         |
| 12                     | U1 -NA (in°)                       | .0967               | 1.7013    | .998    | .5833                | 1.7013    | .937    | .4867                 | 1.7013    | .956    |
| 13                     | U1-NA (in mm)                      | .5400               | .8143     | .785    | .0667                | .8143     | .996    | .6067                 | .8143     | .737    |
| 14                     | L1to NB (In°)                      | 4.5867*             | 1.7064    | .023    | 1.0733               | 1.7064    | .805    | 3.5133                | 1.7064    | .105    |
| 15                     | L1 -NB (in mm)                     | .8633               | .6766     | .412    | .0933                | .6766     | .990    | .9567                 | .6766     | .338    |
| 16                     | AB II OP (in mm)                   | 1.0133              | .8700     | .477    | 1.0167               | .8700     | .475    | 2.0300                | .8700     | .056    |
| SOFT TISSUE PARAMETERS |                                    |                     |           |         |                      |           |         |                       |           |         |
| 17                     | Upper lip Protrusion (in mm)       | .5833               | .4844     | .454    | .1067                | .4844     | .974    | .6900                 | .4844     | .333    |
| 18                     | Lower lip protrusion (in mm)       | .7567               | .8585     | .653    | 1.3733               | .8585     | .251    | .9567                 | .6766     | .338    |
| 19                     | Nasolabial angle (in°)             | 6.5633*             | 2.2933    | .014    | 1.3733               | .8585     | .251    | 4.0100                | 2.2933    | .193    |
| 20                     | Facial convexity (in°)             | 1.9467              | 1.4392    | .370    | .1933                | 1.4392    | .990    | 2.1400                | 1.4392    | .302    |
| 21                     | Z angle upperlip (ino)             | .0533               | 1.8844    | 1.000   | 2.5533               | 2.2933    | .508    | 2.0233                | 1.8844    | .533    |
| 22.                    | Z angle lower lip(in)              | .5600               | 2.5200    | .973    | 3.5067               | 2.5200    | .350    | 2.9467                | 2.5200    | .475    |

P>.05 Non-Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.

**Table 7 shows: Overall Intergroup Comparison of Skeletal, Dental and Soft Tissue Parameters of Group I, II & III:**

Inter group comparison for **SNA** significant statistical difference was seen only for group I verses II ( $P=.010$ ), whereas group I verses II and group II verses III did not show statistically significant difference. For **ANB Angle** ( $p=0.000$ ), significant statistical difference was seen only for group I verses group III, whereas group II verses III and group I verses group II did not show significant statistical difference. **L1-NB** ( $p=0.023$ ) values showed significant statistical difference between group I and II, whereas group I verses III and group I verses II did not show statical significant difference., For **Nasolabial Angle** ( $p=0.014$ ), it was found only for group I statistically significant difference ( $p=0.014$ ) II, whereas group I verses III and group II verses III did not show statical significant difference.

Skeletal parameter **SNB, N perpendicular to point A, N perpendicular to point B, Co-A, Co -Gn, Maxillary Length Mandibular Length, Mandibular plane**. Dental Parameters, **U1-NA, U1-NA, L1-NB, AB II OP**.

**Soft Tissue Parameters-Upper lip protrusion, Lower lip protrusion, Facial Convexity and Z Angle upper and lower lip** showed non-significant statistical difference for all the Comparison groups

**Table 8: Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for Female of Group I (Class I Malocclusion)**

| SI No.                        | PARAMETER                         | MEAN $\pm$ Std. Deviation | Std. Error | Minimum | Maximum |
|-------------------------------|-----------------------------------|---------------------------|------------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                                   |                           |            |         |         |
| 1                             | SNA (in°)                         | 80.973 $\pm$ 2.6245       | .6776      | 75.4    | 84.7    |
| 2                             | SNB (in°)                         | 78.073 $\pm$ 3.1434       | .8116      | 71.8    | 82.5    |
| 3                             | ANB (in°)                         | 2.827 $\pm$ .8379         | .2163      | 1.2     | 3.6     |
| 4                             | N perpendicular to point A(in mm) | 2.0067 $\pm$ 3.43812      | .88772     | -3.40   | 7.2     |
| 5                             | N perpendicular to point B(in mm) | 1.007 $\pm$ 4.2101        | 1.0870     | -9.2    | 7.20    |
| 6                             | Co- A (in mm)                     | 74.447 $\pm$ 13.4882      | 3.4826     | 37.5    | 98.7    |
| 7                             | Co- Gn (in mm)                    | 97.247 $\pm$ 11.9062      | 3.0742     | 79.1    | 125.1   |
| 8                             | Mx-Mand diff (in mm)              | 20.647 $\pm$ 4.0715       | 1.0513     | 13.5    | 28.4    |
| 9                             | Mx Length (in mm)                 | 45.213 $\pm$ 7.1731       | 1.8521     | 30.8    | 59.1    |
| 10                            | Mand Length (in mm)               | 64.400 $\pm$ 7.2006       | 1.8592     | 52.3    | 80.8    |
| 11                            | Mand Plane (in°)                  | 32.447 $\pm$ 4.3517       | 1.1236     | 25.4    | 39.3    |
| <b>DENTAL PARAMETERS</b>      |                                   |                           |            |         |         |
| 12                            | U1 –NA (in°)                      | 34.053 $\pm$ 6.3840       | 1.6483     | 21.6    | 44.3    |
| 13                            | U1-NA (in mm)                     | 8.627 $\pm$ 4.0441        | 1.0442     | 1.9     | 16.0    |
| 14                            | L1to NB (in°)                     | 35.320 $\pm$ 10.3489      | 2.6721     | 18.8    | 52.7    |
| 15                            | L1 -NB (in mm)                    | 8.620 $\pm$ 4.0100        | 1.0354     | 2.8     | 14.0    |
| 16                            | AB II OP (in mm)                  | 4.060 $\pm$ 3.0059        | .7761      | .3      | 10.0    |
| <b>SOFT TISSUE PARAMETERS</b> |                                   |                           |            |         |         |
| 17                            | Upper lip Protrusion (in mm)      | 6.213 $\pm$ 1.7908        | .4624      | 2.4     | 9.3     |
| 18                            | Lower lip protrusion (in mm)      | -6.367 $\pm$ 3.5191       | .9086      | -12.9   | -4      |
| 19                            | Nasolabial angle (in°)            | 102.033 $\pm$ 7.3328      | 1.8933     | 92.0    | 118.0   |
| 20                            | Facial convexity (in°)            | 16.760 $\pm$ 4.9347       | 1.2741     | 10.9    | 28.3    |
| 21                            | Z angle upperlip (in°)            | 67.013 $\pm$ 8.9088       | 2.3002     | 50.3    | 82.1    |
| 22                            | Z angle Lowerlip (in°)            | 62.620 $\pm$ 7.8453       | 2.0256     | 48.7    | 73.9    |

**Table 9: Descriptive Statistics for Skeletal, Dental and Soft Tissue Parameters for Females of Group II (Class II div 1 Malocclusion)**

| SI No.                        | PARAMETER                         | MEAN±Std.Deviation | Std.Error | Minimum | Maximum |
|-------------------------------|-----------------------------------|--------------------|-----------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                                   |                    |           |         |         |
| 1                             | SNA (in°)                         | 84.500±3.1706      | .8187     | 79.0    | 89.3    |
| 2                             | SNB (in°)                         | 78.500±3.3520      | 0.8655    | 72.7    | 84.5    |
| 3                             | ANB (in°)                         | 5.453±1.9131       | .4940     | .6      | 8.7     |
| 4                             | N perpendicular to point A(in mm) | 3.5133±2.24686     | .58014    | .60     | 8.60    |
| 5                             | N perpendicular to point B(in mm) | -3.627±4.5053      | 1.1633    | -11.8   | 1.9     |
| 6                             | Co- A (in mm)                     | 78.067±7.7338      | 1.9968    | 64.4    | 96.0    |
| 7                             | Co- Gn (in mm)                    | 96.347±8.3634      | 2.1594    | 80.0    | 112.0   |
| 8                             | Mx-Mand diff (in mm)              | 18.527±4.7423      | 1.2245    | 11.3    | 29.2    |
| 9                             | Mx Length (in mm)                 | 49.313±3.5916      | .9274     | 44.6    | 58.1    |
| 10                            | Mand Length (in mm)               | 63.653±7.9667      | 2.0570    | 53.5    | 87.5    |
| 11                            | Mand Plane (in°)                  | 29.840±5.1978      | 1.3421    | 24.6    | 41.4    |
| <b>DENTAL PARAMETERS</b>      |                                   |                    |           |         |         |
| 12                            | U1 –NA (in°)                      | 31.607±5.0661      | 1.3081    | 24.8    | 39.7    |
| 13                            | U1-NA (in mm)                     | 8.024±2.9106       | .7515     | 2.3     | 12.5    |
| 14                            | L1to NB (in°)                     | 29.833±3.4238      | .8840     | 23.2    | 34.2    |
| 15                            | L1 -NB (in mm)                    | 7.100±1.6384       | .4230     | 4.1     | 10.0    |
| 16                            | AB II OP (in mm)                  | 3.053±2.3068       | .5956     | .1      | 8.5     |
| <b>SOFT TISSUE PARAMETERS</b> |                                   |                    |           |         |         |
| 17                            | Upper lip Protrusion (in mm)      | 6.507±1.1949       | .3085     | 3.9     | 8.0     |
| 18                            | Lower lip protrusion (in mm)      | -3.727±4.3140      | 1.113     | -9.4    | 8.5     |
| 19                            | Nasolabial angle (in°)            | 97.427±9.3796      | 4.4218    | 80.7    | 118.6   |
| 20                            | Facial convexity (in°)            | 18.727±5.0082      | 1.2931    | 11.3    | 26.1    |
| 21                            | Z angle upperlip (in°)            | 63.293±5.6449      | 1.4575    | 58.4    | 77.4    |
| 22                            | Z angle Lowerlip (in°)            | 62.913±8.5000      | 2.1947    | 54.2    | 79.9    |

**Table 10: Descriptive statistics for Skeletal, Dental and Soft Tissue Parameters for female of Group III (Class II division 1 subdivision Malocclusion)**

| Sl No.                        | PARAMETER                          | MEAN±Std.Deviation | St. Error | Minimum | Maximum |
|-------------------------------|------------------------------------|--------------------|-----------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                                    |                    |           |         |         |
| 1                             | SNA (in°)                          | 83.633±5.1202      | 1.3220    | 74.6    | 91.9    |
| 2                             | SNB (in°)                          | 78.080±4.9099      | 1.2677    | 70.3    | 89.3    |
| 3                             | ANB (in°)                          | 5.687±1.5505       | 0.4003    | 4.1     | 9.6     |
| 4                             | N perpendicular to point A (in mm) | 3.8867±2.70499     | 0.69842   | -0.40   | 11.70   |
| 5                             | N perpendicular to point B (in mm) | -1.600±4.2458      | 1.0963    | -7.6    | 8.0     |
| 6                             | Co- A (in mm)                      | 75.367±10.0867     | 2.6044    | 59.3    | 93.8    |
| 7                             | Co- Gn (in mm)                     | 93.020±12.9408     | 3.3413    | 68.2    | 117.6   |
| 8                             | Mx-Mand diff (in mm)               | 17.653±4.9894      | 1.2883    | 8.9     | 27.9    |
| 9                             | Mx Length (in mm)                  | 45.813±9.7345      | 2.5134    | 32.3    | 62.7    |
| 10                            | Mand Length (in mm)                | 59.687±7.6306      | 1.9702    | 47.05   | 74.9    |
| 11                            | Mand Plane (in°)                   | 30.980±5.9198      | 1.5285    | 22.6    | 41.0    |
| <b>DENTAL PARAMETERS</b>      |                                    |                    |           |         |         |
| 12                            | U1 -NA (in°)                       | 30.333±7.4099      | 1.9132    | 19.5    | 41.5    |
| 13                            | U1-NA (in mm)                      | 6.860±3.5116       | .9067     | 1.5     | 11.3    |
| 14                            | L1to NB (in°)                      | 29.627±5.8629      | 1.5138    | 21.1    | 44.1    |
| 15                            | L1 -NB (in mm)                     | 6.340±2.4342       | .6285     | 3.0     | 11.2    |
| 16                            | AB II OP (in mm)                   | 2.680±3.5011       | .9040     | -2.9    | 8.5     |
| <b>SOFT TISSUE PARAMETERS</b> |                                    |                    |           |         |         |
| 17                            | Upper lip Protrusion (in mm)       | 5.620±1.8190       | .4697     | 2.3     | 8.8     |
| 18                            | Lower lip protrusion (in mm)       | -4.613±2.7679      | .7147     | -11.0   | .0      |
| 19                            | Nasolabial angle (in°)             | 98.800±9.4536      | 2.4409    | 81.6    | 114.7   |
| 20                            | Facial convexity (in°)             | 17.147±6.5785      | 1.6986    | 1.1     | 2.7     |
| 21                            | Z angle upperlip (in°)             | 68.413±7.0219      | 1.8130    | 54.6    | 82.5    |
| 22                            | Z angle Lowerlip (in°)             | 64.633±11.6865     | 3.0174    | 41.3    | 82.8    |

**Table 11: Comparative Statistics, of Skeletal, Dental and Soft Tissue Parameters for Females of Group I, II, III**

| Sl No.                        | Overall                      | Group I        | GroupII        | Group III      | ANOVA    |
|-------------------------------|------------------------------|----------------|----------------|----------------|----------|
|                               |                              | MEAN±SD        | MEAN±SD        | MEAN±SD        | P- value |
| <b>SKELETAL PARAMETERS</b>    |                              |                |                |                |          |
| 1                             | SNA (In°)                    | 80.973±2.6245  | 84.500±3.1706  | 83.633±5.1202  | .039     |
| 2                             | SNB (In°)                    | 78.073±3.1434  | 78.500±3.3520  | 78.080±4.9099  | .942     |
| 3                             | ANB (In°)                    | 2.827±.8379    | 5.453±1.9131   | 5.687±1.5505   | .000     |
| 4                             | N perpendicular A (In mm)    | 2.0067±3.43812 | 3.5133±2.24686 | 3.8867±2.70499 | .171     |
| 5                             | N perpendicular B (In mm)    | 1.007±4.2101   | 3.627±4.5053   | 1.600±4.2458   | .232     |
| 6                             | Co- A (in mm)                | 74.447±13.4882 | 78.067±7.7338  | 75.367±10.0867 | .632     |
| 7                             | Co- Gn (in mm)               | 97.247±11.9062 | 96.347±8.3634  | 93.020±12.9408 | .560     |
| 8                             | Mx-Mand diff (in mm)         | 20.647±4.0715  | 18.527±4.7423  | 17.653±4.9894  | .201     |
| 9                             | Mx Length (in mm)            | 45.213±7.1731  | 49.313±3.5916  | 45.813±9.7345  | .261     |
| 10                            | Mand Length (in mm)          | 64.400±7.2006  | 63.653±7.9667  | 59.687±7.6306  | .202     |
| 11                            | Mand Plane (In°)             | 32.447±4.3517  | 29.840±5.1978  | 30.980±5.9198  | .395     |
| <b>DENTAL PARAMETERS</b>      |                              |                |                |                |          |
| 12                            | U1 –NA (In°)                 | 34.053±6.3840  | 31.607±5.0661  | 30.333±7.4099  | .276     |
| 13                            | U1-NA (in mm)                | 8.627±4.0441   | 8.020±2.9106   | 6.860±3.5116   | .385     |
| 14                            | L1to NB (In°)                | 35.320±10.3489 | 29.833±3.4238  | 29.627±5.8629  | .057     |
| 15                            | L1 -NB (in mm)               | 8.620±4.0100   | 7.100±1.6384   | 6.340±2.4342   | .098     |
| 16                            | AB II OP (in mm)             | 4.060±3.0059   | 3.053±2.3068   | 2.680±3.5011   | .430     |
| <b>SOFT TISSUE PARAMETERS</b> |                              |                |                |                |          |
| 17                            | Upper lip Protrusion (in mm) | 6.213±1.7908   | 6.507±1.1949   | 5.620±1.8190   | .325     |
| 18                            | Lower lip protrusion (in mm) | 6.367±3.5191   | 3.727±4.3140   | 4.613±2.7679   | .135     |
| 19                            | Nasolabial angle (In°)       | 102.033±7.3328 | 97.427±9.3796  | 98.800±9.4536  | .346     |
| 20                            | Facial convexity (In°)       | 16.760±4.9347  | 18.727±5.0082  | 17.147±6.5785  | .594     |
| 21                            | Z angle upperlip (In°)       | 67.013±8.9088  | 66.293±5.6449  | 68.413±7.0219  | .724     |
| 22                            | Z angle lower lip (In°)      | 62.620±7.8453  | 62.913±8.5000  | 64.633±11.6865 | .822     |

P>.05 Non-Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.

**Table 11 shows Comparative Statistics, of Skeletal, Dental and Soft Tissue Parameters for Females of Group I, II, III**

### **SKELETAL PARAMETERS**

On comparing **SNA** angle between groups, it was seen that highest value of ( $84.500^{\circ} \pm 3.1706^{\circ}$ ) was in Group II, followed by Group III ( $83.633^{\circ} \pm 5.1202^{\circ}$ ) and then group I ( $80.973^{\circ} \pm 2.6245^{\circ}$ ). (Group II>III>I) and the difference was statistically significant difference between the groups. (P=0.039).

**SNB** angle showed, highest value of ( $78.500^{\circ} \pm 3.3520^{\circ}$ ) in Group II, followed by Group III ( $78.080^{\circ} \pm 4.9099^{\circ}$ ) and then group I ( $78.073^{\circ} \pm 3.1434^{\circ}$ ), (Group II>III>I) but there were no statistically significant differences between the groups. (P=0.942).

**ANB** angle, showed highest Mean value of ( $5.687^{\circ} \pm 1.5505^{\circ}$ ) was in Group III, followed by Group II ( $5.453^{\circ} \pm 1.9131^{\circ}$ ) and then Group I ( $2.827 \pm 0.8379^{\circ}$ ) (Group III>II>I), but there was no statistically significant differences between the groups (P=0.00).

On comparing mean values of **N perpendicular to point A**, it was seen that Maxilla was more forwardly positions ( $3.8867 \pm 2.70499$ mm) in Group III followed by Group II ( $3.5133 \pm 2.24686$ mm) and then group I ( $2.0067 \pm 3.43812$ mm) group (III>II>I) but there was no statistically significant differences between the groups (P=0.171)

On comparing the mean linear distance between point **N perpendicular to point B**, it was seen that mandible was more forwardly positioned in group II ( $3.627 \pm 4.5053$ mm) followed Group III ( $1.600 \pm 4.2458$ mm) and then group I ( $1.007 \pm 4.2101$ mm) Group (II>III>I) but there was no statistically significant differences between the groups (P=0.232).

**Effective Maxillary length (Co-point A)** was maximum in group II ( $78.067 \pm 7.7338$  mm) followed by Group III ( $75.367 \pm 10.0867$  mm) and then group I ( $74.447 \pm 13.4882$ mm) Group (II>III>I) but there were no statistically significant differences between the groups .(P=.632).

**Effective Mandibular length(Co-Gn)** was highest in group I ( $97.247 \pm 11.9062$  mm) followed by Group II ( $96.347 \pm 8.3634$  mm) and then group III ( $93.020 \pm 12.9408$  mm) , ( Group I>II>III) but there were no statistically significant differences between the groups (P=.560).

**Maxillary Mandibular difference** was highest in group I ( $20.647 \pm 4.0715$  mm) followed by Group II ( $18.527 \pm 4.7423$  mm) and then group III ( $17.653 \pm 4.9894$  mm), (Group I>II>III) but there were no statistically significant differences between the groups ( $P=.201$ ).

The mean value of **maxillary length** between groups was highest in group II ( $49.313 \pm 3.5916$  mm) followed by group III ( $45.813 \pm 9.7345$  mm) and then group I ( $45.213 \pm 7.1731$  mm) group (II>III>I) but there was not statistically significant between the groups ( $P=0.261$ ).

The mean value of **mandible length** between groups was highest in group I ( $64.400 \pm 7.2006$  mm) followed by group II ( $63.653 \pm 7.9667$  mm) and then group III ( $59.687 \pm 7.6306$  mm), Group (I>II>III) but there was no statistically significant difference between the Group. ( $P=.202$ ).

The mean value of **Mn plane angle (S-N to Go- Gn)** between groups, was highest in group I ( $32.447^\circ \pm 4.3517^\circ$ ) followed by group III ( $30.980^\circ \pm 5.9198^\circ$ ) and then group II ( $29.840^\circ \pm 5.1978^\circ$ ). Group (I>III>II) but there was no statistically significant difference between the Group. ( $P=.395$ ).

**DENTAL PARAMETERS** Angle measured between **long axis of Maxillary Incisor to line drawn Nasion to point A (UI-NA)** was highest in group I ( $34.053^\circ \pm 6.3840^\circ$ ) followed by group II ( $31.607^\circ \pm 5.0661^\circ$ ) and then group III ( $30.333^\circ \pm 7.4099^\circ$ ) Group (I>II>III) but there was no statistically significant differences between the Group. ( $P=.276$ ).

Linear distance measured from **anterior point of maxillary 1 to line drawn from Nasion to Point A (UI-NA linear)** was highest in group I ( $8.627 \pm 4.0441$  mm) followed by group II ( $8.020 \pm 2.9106$  mm) and then group III ( $6.860 \pm 3.5116$  mm) Group (I>II>III) but there was no statistically significant differences between the Group ( $P=.385$ ).

The angle measured between long axis of mandibular incisor to line drawn from **nasion to point B (L1-NB)** was highest in group I ( $35.320^\circ \pm 10.3489^\circ$ ) followed by group II ( $29.833^\circ \pm 3.4238^\circ$ ) and then group III ( $29.627^\circ \pm 5.8629^\circ$ ) Group (I>III>II) but there was no statistically significant differences between the Group. ( $P=0.057$ ).

Linear distance measured from anterior point of mandibular incisor to line drawn from **nasion to point B. (L1-NB Linear)** was highest in group I ( $8.620 \pm 4.0100$  mm) followed by group II ( $7.100 \pm 1.6384$  mm) and then group III ( $6.340 \pm 2.4342$  mm), Group (I>II>III) but there were no statistically significant differences between the Group ( $P=.098$ ).

The distance between perpendicular projection of **Point A and Point B on functional occlusal plane (AB II OP)** was seen highest value of (4.060±3.0059mm) was in Group I, followed by Group II (3.053±2.3068mm) and then group III (2.680 +3.5011mm) Group (I>II>III) but there was no statistically significant differences between the groups. (P=0.430).

**Soft tissue Parameters-**

On comparing mean value of **Upper Lip Protusion** between groups, It was seen highest value of (6.507±1.1949mm) was in Group II, followed by Group I (6.213± 1.7908mm) and then group III (5.620±1.8190mm) Group (II>I>III) but there was no statistically significant differences between the Group . (P=0.325)'

**Lower Lip Protrusion** between groups, highest value of ( $6.367 \pm 3.5191\text{mm}$ ) was in Group I, followed by Group III ( $4.613 \pm 2.7679\text{mm}$ ) and then group II ( $3.727 \pm 4.3140\text{mm}$ ) Group (I>III>II) but there was no statistically significant differences between the groups. ( $P=0.135$ ).

The value of **nasolabial angle** between groups, was highest in Group I ( $102.033^\circ \pm 7.3328^\circ$ ) followed by Group III ( $98.800^\circ \pm 9.4536^\circ$ ) and then group II ( $97.427^\circ \pm 9.3796^\circ$ ) Group (I>III>II) but there was statistically significant differences between the groups. ( $P=0.346$ ).

**Facial convexity** highest value of ( $18.727 \pm 5.0082^\circ$ ) in Group II, followed by Group III ( $17.147^\circ \pm 6.5785^\circ$ ) and then group I ( $16.760 \pm 4.9347$ ) Group (II>III>I) but there were no statistically significant differences between the groups. ( $P=0.594$ ).

The value of **Z angle upper lip** was highest in Group III ( $68.413^\circ \pm 7.0219^\circ$ ), followed by Group I ( $67.013^\circ \pm 8.9088^\circ$ ) and then group II ( $66.293^\circ \pm 5.6449^\circ$ ) Group (III>I>II) but there were no statistically significant differences between the groups. ( $P=0.724$ ).

The value of **Z angle lower lip** was highest in Group III ( $64.633^\circ \pm 11.6865^\circ$ ), followed by Group II ( $62.913^\circ \pm 8.5000^\circ$ ) and then group I ( $62.620^\circ \pm 7.8453^\circ$ ) Group (III>II>I) but there was statistically significant differences between the groups. ( $P=0.822$ ).

**Table 12: Intergroup Comparison of Cephalometric Skeletal, Dental and Soft Tissue Parameters Among Female of Group I, II, III**

| S.No                   | Parameters                         | Group I vs Group II |           |         | Group I vs Group II |           |         | Group II vs Group III |           |         |
|------------------------|------------------------------------|---------------------|-----------|---------|---------------------|-----------|---------|-----------------------|-----------|---------|
|                        |                                    | Mean diff           | Std error | P value | Mean diff           | Std error | P value | Mean diff             | Std error | P value |
| SKELETAL PARAMETERS    |                                    |                     |           |         |                     |           |         |                       |           |         |
| 1                      | SNA (in°)                          | -3.5267             | 1.3850    | .038    | -2.6600             | 1.3850    | .145    | .8667                 | 1.3850    | .807    |
| 2                      | SNB (in°)                          | .4267               | 1.4177    | .951    | .0067               | 1.4177    | 1.000   | .4200                 | 1.4177    | .953    |
| 3                      | ANB (in°)                          | -2.6267             | .5484     | .000    | -2.8600             | .5484     | .000    | -2333                 | .5484     | .905    |
| 4                      | N perpendicular to point A(in mm)  | -1.50667            | 1.03679   | .324    | -1.88000            | 1.03679   | .178    | .37333                | 1.06679   | .931    |
| 5                      | N perpendicular to point B (in mm) | 2.6200              | 1.5783    | .232    | .5933               | 1.5783    | .925    | -2.0267               | 1.5783    | .412    |
| 6                      | Co-A (in mm)                       | -3.6200             | 3.9072    | .627    | -.9200              | 3.9072    | .970    | 2.7000                | 3.9.72    | .770    |
| 7                      | Co-Gn (in mm)                      | .9000               | 4.1051    | .974    | 4.2267              | 4.1051    | .563    | 3.3267                | 4.1051    | .699    |
| 8                      | Mx-Mand diff (in mm)               | 2.1200              | 1.6860    | .427    | 2.9933              | 1.6860    | .190    | .8733                 | 1.6860    | .863    |
| 9                      | Mx Length (in mm)                  | -4.1000             | 2.6593    | .282    | -.6000              | 2.6593    | .972    | 3.5000                | 2.6593    | .394    |
| 10                     | Mand Length (in mm)                | .7467               | 2.7772    | .961    | 4.7133              | 2.7772    | .218    | 3.9667                | 2.7772    | .336S   |
| 11                     | Mand Plane (in°)                   | 2.6067              | 1.8973    | .364    | 1.4667              | 1.8973    | .721    | -1.1400               | 1.8973    | .820    |
| DENTAL PARAMETERS      |                                    |                     |           |         |                     |           |         |                       |           |         |
| 12                     | U1 –NA (in°)                       | 2.4467              | 2.3221    | .548    | 3.7200              | 2.3221    | 0.256   | 1.2733                | 2.3221    | .848    |
| 13                     | U1-NA (in mm)                      | .6067               | 1.2851    | .885    | 1.7667              | 1.2851    | .363    | 1.1600                | 1.2581    | .642    |
| 14                     | L1to NB (In°)                      | 5.4867              | 2.6094    | .101    | 5.6933              | 2.6094    | .086    | .2067                 | 2.6094    | .997    |
| 15                     | L1 –NB (in mm)                     | 1.5200              | 1.0475    | .325    | 2.2800              | 1.0475    | 0.087   | .7600                 | 1.0475    | .750    |
| 16                     | AB II OP (in mm)                   | 1.0067              | 1.806     | .627    | 1.3800              | 1.0876    | .420    | .3733                 | 1.0876    | .937    |
| SOFT TISSUE PARAMETERS |                                    |                     |           |         |                     |           |         |                       |           |         |
| 17                     | Upper lip Protrusion (in mm)       | -.2933              | .5942     | .875    | .5933               | .5942     | .582    | .8867                 | .5942     | .305    |
| 18                     | Lower lip protrusion (in mm)       | 2.6400              | 1.3107    | .121    | -1.7533             | 1.3107    | .383    | .8867                 | 1.3107    | .778    |
| 19                     | Nasolabial angle (in°)             | 4.6067              | 3.2050    | .331    | 3.2333              | 3.2050    | .575    | -1.3733               | 3.2050    | .904    |
| 20                     | Facial convexity (in°)             | -1.9667             | 2.0299    | .600    | -.3867              | 2.0299    | .980    | 1.5800                | 2.0299    | .718    |
| 21                     | Z angle upperlip (ino)             | .7200               | 2.6712    | .961    | -1.4000             | 2.6712    | .860    | -2.1200               | 2.6712    | .709    |
| 22                     | Z angle lower lip(ino)             | -.2933              | 3.4665    | 0.996   | -2.0133             | 3.4665    | .831ss  | -1.7200               | 3.4665    | .874    |

**P>.05 Non-Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.**

**Table 12 shows: Intergroup Comparison of Cephalometric Skeletal, Dental and Soft Tissue Parameters Among Female of Group I, II, III .**

On inter group comparison for **SNA** ( $p=0.38$ ), significant statistical difference was seen only for group I verses II, whereas group I verses III and group II verses III did not show statistical significant difference.

For **ANB Angle** ( $p=0.000$ ), significant statistical difference was seen group I verses group II, group I verses III and group II verses group III did not show significant statistical difference.

Skeletal parameter **SNB, N perpendicular to point A, N perpendicular to point B, Co-A, Co -Gn, Maxillary Length Mandibular Length, Mandibular plane.**

Dental Parameters, **U1-NA, U1-NA, L1-NB, L1-NBmm, AB II OP.** Soft tissue parameters **Upper lip protrusion ,Lower lip protrusion, Nasolabial angle ,Facial Convexity and Z Angle upper and lower lip** showed non-significant statistical difference for all the Comparison groups.

**Table 13: Descriptive Statistics for Skeletal Dental and Soft Tissue Parameters for Males of Group I (Class 1 Malocclusion)**

| S. No.                       | Parameter                          | MEAN±Std. Deviation | Std. Error | Minimum | Maximum |
|------------------------------|------------------------------------|---------------------|------------|---------|---------|
| <b>SKELETAL PARAMETERS</b>   |                                    |                     |            |         |         |
| 1                            | SNA (in°)                          | 82.573±4.0501       | 1.0456     | 73.6    | 87.8    |
| 2                            | SNB (in°)                          | 79.813±4.5532       | 1.1756     | 70.1    | 86.7    |
| 3                            | ANB (in°)                          | 2.760±.9701         | .2505      | 1.1     | 4.0     |
| 4                            | N perpendicular to point A(in mm)  | 1.6267±3.09503      | .79913     | 3.580   | 7.90    |
| 5                            | N perpendicular to point B (in mm) | -1.340±5.0280       | 1.2982     | -8.5    | 7.8     |
| 6                            | Co- A (in mm)                      | 81.553±14.9232      | 3.8532     | 62.8    | 122.9   |
| 7                            | Co- Gn (in mm)                     | 104.407±17.2054     | 4.4424     | 79.5    | 152.3   |
| 8                            | Mx-Mand diff (in mm)               | 22.793±3.9860       | 1.0292     | 14.8    | 29.4    |
| 9                            | Mx Length (in mm)                  | 51.387±9.1245       | 2.3559     | 40.5    | 77.0    |
| 10                           | Mand Length (in mm)                | 69.953±15.5594      | 4.0174     | 53.7    | 117.1   |
| 11                           | Mand Plane (in°)                   | 31.433±6.2059       | 1.624      | 22.4    | 47.0    |
| <b>DENAL PARAMETERS</b>      |                                    |                     |            |         |         |
| 12                           | U1 –NA (in°)                       | 27.587±5.8600       | 1.5131     | 20.1    | 37.5    |
| 13                           | U1-NA (in mm)                      | 6.847±2.5668        | .6627      | 2.6     | 11.2    |
| 14                           | L1to NB (in°)                      | 29.913±7.7072       | 1.9900     | 14.7    | 43.1    |
| 15                           | L1 -NB (in mm)                     | 6.140±2.2702        | .5862      | .8      | 9.3     |
| 16                           | AB II OP (in mm)                   | 5.680±5.5629        | 1.1781     | 1.1     | 18.4    |
| <b>SOFT TSSUE PARAMETERS</b> |                                    |                     |            |         |         |
| 17                           | Upper lip Protrusion (in mm)       | 4.953±1.8650        | .4816      | 1.6     | 7.3     |
| 18                           | Lower lip protrusion (in mm)       | -3.767±3.0479       | .7870      | -10.5   | 2.5     |
| 19                           | Nasolabial angle (in°)             | 104.487±8.0011      | 2.0659     | 93.1    | 119.1   |
| 20                           | Facial convexity (in°)             | 18.813±6.4215       | 1.6580     | 8.3     | 31.6    |
| 21                           | Z angle upperlip (in°)             | 68.993±7.3144       | 1.886      | 56.5    | 81.2    |
| 22                           | Z angle Lowerlip (in°)             | 66.227±10.2780      | 2.6538     | 40.9    | 83.7ss  |

**Table 14: Descriptive Statistics for Skeletal Dental and Soft Tissue Parameters for Males of Group II (Class II Division 1 Malocclusion)**

| S.No.                         | Parameter                         | MEAN±Std. Deviation | Std. Error | Minimum | Maximum |
|-------------------------------|-----------------------------------|---------------------|------------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                                   |                     |            |         |         |
| 1                             | SNA (in°)                         | 84.807±3.5568       | .9184      | 79.6    | 93.2    |
| 2                             | SNB (in°)                         | 79.313±4.1639       | 1.0751     | 73.6    | 89.8    |
| 3                             | ANB (in°)                         | 5.793±.8988         | .2321      | 4.1     | 7.7     |
| 4                             | N perpendicular to point A(in mm) | 1.9600±2.04374      | .52769     | -1.60   | 6.20    |
| 5                             | N perpendicular to point B(in mm) | -3.920±4.1825       | 1.0799     | -9.7    | 2.6     |
| 6                             | Co- A (in mm)                     | 80.260±8.0001       | 2.0656     | 63.0    | 91.6    |
| 7                             | Co- Gn (in mm)                    | 102.227±10.9755     | 2.8339     | 78.0    | 114.2   |
| 8                             | Mx-Mand diff (in mm)              | 21.887±4.7590       | 1.2288     | 13.4    | 33.1    |
| 9                             | Mx Length (in mm)                 | 47.047±5.4626       | 1.4104     | 37.0    | 54.7    |
| 10                            | Mand Length (in mm)               | 66.893±8.5220       | 2.2004     | 53.9    | 83.6    |
| 11                            | Mand Plane (in°)                  | 31.760±54806        | 1.4151     | 24.2    | 40.8    |
| <b>DENTAL PARAMETERS</b>      |                                   |                     |            |         |         |
| 12                            | U1 -NA (in°)                      | 30.227±5.8159       | 1.5017     | 21.6    | 40.1    |
| 13                            | U1-NA (in mm)                     | 6.373±2.9339        | .7575      | 1.1     | 12.4    |
| 14                            | L1to NB (in°)                     | 26.227±4.1520       | 1.0720     | 17.7    | 32.9    |
| 15                            | L1 -NB (in mm)                    | 5.933±1.6990        | .4387      | 4.1     | 9.4     |
| 16                            | AB II OP (in mm)                  | 4.660±3.1284        | .8077      | .6      | 10.9    |
| <b>SOFT TISSUE PARAMETERS</b> |                                   |                     |            |         |         |
| 17                            | Upper lip Protrusion (in mm)      | 5.827±2.2585        | .5831      | 1.2     | 9.5     |
| 18                            | Lower lip protrusion (in mm)      | -4.893±2.5415       | .6562      | -9.5    | -2      |
| 19                            | Nasolabial angle (in°)            | 95.967±10.4906      | 2.7087     | 81.1    | 120.3   |
| 20                            | Facial convexity (in°)            | 20.740±4.5665       | 1.1791     | 12.9    | 27.5    |
| 21                            | Z angle upperlip (in°)            | 69.607±7.5117       | 1.9395     | 60.1    | 86.1    |
| 22                            | Z angle Lowerlip (in°)            | 67.053±9.7348       | 2.5135     | 53.0    | 85.5    |

**Table 15: Descriptive Statistics for Skeletal Dental and Soft Tissue Parameters for Group III (Class II Division 1 Subdivision Malocclusion).**

| Sl No.                        | Parameter                         | MEAN±Std. Deviation | Std. Error | Minimum | Maximum |
|-------------------------------|-----------------------------------|---------------------|------------|---------|---------|
| <b>SKELETAL PARAMETERS</b>    |                                   |                     |            |         |         |
| 1                             | SNA (in°)                         | 82.220±3.4876       | .9005      | 76.7    | 88.7    |
| 2                             | SNB (in°)                         | 76.813±3.4985       | .9033      | 71.6    | 82.6    |
| 3                             | ANB (in°)                         | 5.380±1.6054        | .4145      | 4.1     | 10.4    |
| 4                             | N perpendicular to point A(in mm) | 1.5380±3.63824      | .93939     | -4.30   | 7.10    |
| 5                             | N perpendicular to point B(in mm) | -5.220±4.8408       | 1.2499     | -15.9   | 3.2     |
| 6                             | Co- A (in mm)                     | 82.313±7.6492       | 1.9750     | 66.5    | 95.1    |
| 7                             | Co- Gn (in mm)                    | 102.307±9.3216      | 2.4068     | 86.3    | 118.7   |
| 8                             | Mx-Mand diff (in mm)              | 21.467±3.9540       | 1.0209     | 15.0    | 28.5    |
| 9                             | Mx Length (in mm)                 | 51.007±5.6349       | 1.4549     | 42.2    | 59.4    |
| 10                            | Mand Length (in mm)               | 66.047±8.3668       | 2.1603     | 53.9    | 83.6    |
| 11                            | Mand Plane (in°)                  | 28.580±5.5528       | 1.4337     | 21.3    | 42.3    |
| <b>DENTAL PARAMETERS</b>      |                                   |                     |            |         |         |
| 12                            | U1 –NA (in°)                      | 30.333±7.5425       | 1.9475     | 17.0    | 41.0    |
| 13                            | U1-NA (in mm)                     | 7.400±2.4811        | .6406      | 1.9     | 11.2    |
| 14                            | L1to NB (in°)                     | 28.580±4.2859       | 1.1066     | 21.3    | 36.0    |
| 15                            | L1 -NB (in mm)                    | 6.507±2.4285        | .6270      | 3.1     | 11.5    |
| 16                            | AB II OP (in mm)                  | 3.000±3.2393        | .8364      | -7.3    | 8.0     |
| <b>SOFT TISSUE PARAMETERS</b> |                                   |                     |            |         |         |
| 17                            | Upper lip Protrusion (in mm)      | 6.927±1.8262        | .4715      | 3.3     | 9.7     |
| 18                            | Lower lip protrusion (in mm)      | -6.753±2.7368       | .7066      | -9.8    | -1.0    |
| 19                            | Nasolabial angle (in°)            | 99.700±8.9584       | 2.3130     | 84.7    | 117.6   |
| 20                            | Facial convexity (in°)            | 22.707±4.1591       | 1.0739     | 17.0    | 28.4    |
| 21                            | Z angle upperlip (in°)            | 63.547±6.3138       | 1.6302     | 54.3    | 75.1    |
| 22                            | Z angle Lowerlip (in°)            | 58.320±9.1461       | 2.3615     | 46.7    | 73.1    |

**Table 16: Comparative Statistics of Skeletal Dental and Soft Tissue Parameters for Males of Group I, II And III**

| Sl No                 | PARAMETES                    | Group I         | GroupII         | Group III      | ANOV A |
|-----------------------|------------------------------|-----------------|-----------------|----------------|--------|
|                       |                              | MEAN±SD         | MEAN±SD         | MEAN±SD        |        |
| SKELETAL PARAMETERS   |                              |                 |                 |                |        |
| 1                     | SNA (Ino)                    | 82.573±4.051    | 84.807±3.5568   | 82.220±3.4876  | .129   |
| 2                     | SNB (Ino)                    | 79.813±4.5532   | 79.313±4.1639   | 76.813±3.4985  | .112   |
| 3                     | ANB (Ino)                    | 2.760±.9701     | 5.793±.8988     | 5.380±1.6054   | .000   |
| 4                     | N perpendicular A (mm)       | 1.6267±3.09503  | 1.9600±2.04374  | 1.5380±3.63824 | .921   |
| 5                     | N perpendicular B (mm)       | -1.340±5.0280   | -3.920±4.1825   | -5.220±4.8408  | .082   |
| 6                     | Co- A (in mm)                | 81.553±14.9232  | 80.260±8.0001   | 82.313±7.6492  | .869   |
| 7                     | Co- Gn (in mm)               | 104.407±17.2054 | 102.227±10.9755 | 102.307±9.3216 | .873   |
| 8                     | Mx-Mand diff (in mm)         | 22.793±3.9860   | 21.887±4.7590   | 21.467±3.9540  | .685   |
| 9                     | Mx Length (in mm)            | 51.387±9.1245   | 47.047±5.4626   | 51.007±5.6349  | .179   |
| 10                    | Mand Length (in mm)          | 69.953±15.5594  | 66.893±8.5220   | 66.047±8.3668  | .614   |
| 11                    | Mand Plane (Ino)             | 31.433±6.2059   | 31.760±5.4806   | 28.580±5.5528  | .261   |
| DENTAL PARAMETERS     |                              |                 |                 |                |        |
| 12                    | U1 –NA (InO)                 | 27.587±5.8600   | 30.227±5.8159   | 30.333±7.5425  | .426   |
| 13                    | U1-NA (in mm)                | 6.847±2.5668    | 6.373±2.9339    | 7.400±2.4811   | .577   |
| 14                    | L1to NB (InO)                | 29.913±7.7072   | 26.227±4.1520   | 28.5±4.2859    | .204   |
| 15                    | L1 -NB (in mm)               | 6.140±2.27.2    | 5.933±1.6990    | 6.507±2.4285   | .763   |
| 16                    | AB II OP (in mm)             | 5.680±5.5629    | 4.660±3.1284    | 3.000±3.2393   | .148   |
| SOFT TISSUE PARAMTERS |                              |                 |                 |                |        |
| 17                    | Upper lip Protrusion (in mm) | 4.953±1.8650    | 5.827±2.2585    | 6.927±1.8262   | .033   |
| 18                    | Lower lip protrusion (in mm) | -3.767±3.0479   | -4.893±2.5415   | -6.753±2.7368  | .018   |
| 19                    | Nasolabial angle (InO)       | 104.487±8.0011  | 95.967±10.4906  | 99.700±8.9584  | .050   |
| 20                    | Facial convexity (InO)       | 18.813±6.4215   | 20.740±4.5665   | 22.707±4.1591  | .129   |
| 21                    | Z anZ angle upperlip (InO)   | 68.993±7.3144   | 69.607±7.5117   | 63.547±6.3138  | .045   |
| 22                    | Z angle lower lip (InO)      | 66.227±10.2780  | 67.053±9.7348   | 58.320±9.1461  | .034   |

**Table 16: Showes Comparative descriptive Statistics for Skeletal Dental and Soft Tissue Parameters for Male of Group I, Group II, Group III.**

**SKELETAL PARAMETERS**

On comparing **SNA** angle between groups, it was seen that highest value of ( $84.807^{\circ} \pm 3.5568^{\circ}$ ) was in Group II, followed by Group I ( $82.573^{\circ} \pm 4.051^{\circ}$ ) and then group III ( $82.220^{\circ} \pm 3.486^{\circ}$ ). (Group II>I>III) and the difference was no statistically significant difference between the groups. (P=0.129).

**SNB** angle showed, highest value of ( $79.8133^{\circ} \pm 4.5532^{\circ}$ ) in Group I, followed by Group II ( $79.313^{\circ} \pm 4.1639^{\circ}$ ) and then group III ( $76.813^{\circ} \pm 3.4985^{\circ}$ ), (Group I>II>III) but there was no statistically significant differences between the group (P=0.112).

**ANB** angle, showed highest Mean value of ( $5.793^{\circ} \pm .8988^{\circ}$ ) was in Group II, followed by Group III ( $5.380^{\circ} \pm 1.6054^{\circ}$ ) and then Group I ( $2.760^{\circ} \pm 0.9701^{\circ}$ ) (Group II>III>I), and the difference was statistically significant between the groups (P=0.000).

On comparing mean values of **N perpendicular to point A**, it was seen that **Maxilla** was more forwardly positioned ( $1.9600 \pm 2.04374$ ) mm in Group II, followed by Group I ( $1.6267 \pm 3.09503$ ) mm and then group III ( $1.5380 \pm 3.63824$ ) mm group (II>I>III) but there was no statistically significant differences between the group. (P=0.921)

On comparing the mean linear distance between point **N perpendicular to point B**, it was seen that mandible was more forwardly positioned in group I ( $-1.340 \pm 5.0280$ mm) followed Group II ( $-3.920 \pm 4.1825$  mm) and then group III ( $-5.220 \pm 4.8408$ mm) Group (I>II>III) but there were no statistically significant differences between the group. (P=0.082).

**Effective Maxillary length (Co-point A)** was maximum in group III ( $82.313 \pm 7.6492$ mm) followed by Group I ( $81.553 \pm 14.9232$ mm) and then group II ( $80.260 \pm 8.001$ mm) Group (III>I>II) but there were no statistically significant differences between the group. (P=.869).

**Effective Mandibular length (Co-Gn)** was highest in group I ( $104.407 \pm 17.2054$ mm) followed by Group III ( $102.307 \pm 9.3216$ mm) and then group II ( $102.227 \pm 10.9755$  mm), (Group I>III>II) but there were no statistically significant differences between the group (P=.873).

The mean value of **maxillary mandibular difference** between groups was highest in group I ( $22.793 \pm 3.9860$ mm) followed by group II ( $21.887 \pm 4.7590$ mm) and then

group III ( $21.467 \pm 3.9540$ ) group(I>II>III) but there was no statistically significant between the groups( $P=0.685$ ).

The mean value of **maxillary length** between groups was highest in group I ( $51.387 \pm 9.1245\text{mm}$ ) followed by group III ( $51.007 \pm 5.6349\text{mm}$ ) and then group II ( $47.047 \pm 5.4626\text{mm}$ ) group(I>III>II) but there was no statistically significant between the groups( $P=0.179$ ).

The mean value of **mandible length** between groups was highest in group I ( $69.953 \pm 15.5594\text{mm}$ ) followed by group II ( $66.893 \pm 8.5220\text{mm}$ ) and then group III( $66.047 \pm 8.3668\text{mm}$ ) ,Group(I>II>III) but there was no statistically significant difference between the Group.( $P=.614$ )

The mean value of **Mn plane angle (S-N to Go- Gn)** between groups, was highest in group II ( $31.760^\circ \pm 5.4806^\circ$ ) followed by group I ( $31.433^\circ \pm 6.2059^\circ$ ) and then group III( $28.580^\circ \pm 5.5528^\circ$ ) group(II>I>III) but there was no statistically significant difference between the Group.( $P=.261$ )

#### DENTAL PARAMETERS

Angle measured between **long axis of Maxillary Incisor to line drawn Nasion to point A (UI-NA)** was highest in group III ( $30.333^\circ \pm 7.5425^\circ$ ) followed by group II ( $30.227^\circ \pm 5.8159^\circ$ ) and then group I ( $27.587^\circ \pm 5.8600^\circ$ ) Group (III>II>I) but there were no statistically significant differences between the Group. ( $P=.426$ )

Linear distance measured from **anterior point of maxillary 1 to line drawn from Nasion to Point A (UI-NA linear)** was highest in group III ( $7.400 \pm 2.4811\text{ mm}$ ) followed by group I ( $6.847 \pm 2.5668\text{mm}$ ) and then group II ( $6.373 \pm 2.9339\text{mm}$ ) Group (III>I>II) but there were no statistically significant differences between the Group( $P=.577$ )

The angle measured between **long axis of mandibular incisor to line drawn from nasion to point B (L1-NB)** was highest in group I ( $29.913^\circ \pm 7.7072^\circ$ ) followed by group III ( $28.5000^\circ \pm 4.2859^\circ$ ) and then group II ( $26.227^\circ \pm 4.1520^\circ$ ) Group(I>III>II) but there were statistically significant differences found between the Group.( $P=0.204$ )

Linear distance measured from **anterior point of mandibular incisor to line drawn from nasion to point B. (L1-NB Linear)** was highest in group III( $6.507 \pm 2.4285\text{ mm}$ ) followed by group I ( $6.140 \pm 2.272\text{mm}$ ) and then group II ( $5.933 \pm 1.6990\text{mm}$ ),(III>I>II) but there was no statistically significant differences between the Group ( $P=.763$ )

The distance between perpendicular projection of **Point A and Point B on functional occlusal plane (AB II OP)** was seen highest value of ( $5.680 \pm 5.5629\text{mm}$ ) was in Group I, followed by Group II ( $4.660 \pm 3.1284\text{mm}$ ) and then group III ( $3.000 \pm 3.2393\text{mm}$ ) Group (I>II>III) but there were no significant statistical differences between the groups. ( $P=0.148$ )

#### **Soft tissue Parameters**

On comparing mean value of **Upper Lip Protusion** between groups, It was seen highest value of ( $6.927 \pm 1.8262\text{mm}$ ) was in Group III, followed by Group II ( $5.827 \pm 2.2585\text{mm}$ ) and then group I ( $4.953 \pm 1.8650$ ) Group (III>II>I) but there was no significant statistical differences between the groups. ( $P=0.33$ ), .

**Lower Lip Protrusion** between groups, highest value of ( $-3.767 \pm 3.0479\text{mm}$ ) was in Group I , followed by Group II ( $-4.893 \pm 2.5415\text{mm}$ ) and then group III ( $-6.753 \pm 2.7368\text{mm}$ ) Group (I>II>III) but there were significant statistical differences between the groups. ( $P=.018$ ).

The value of **nasolabial angle** between groups, was highest in Group I ( $104.487^\circ \pm 8.0011^\circ$ ) followed by Group III ( $99.700^\circ \pm 8.9584^\circ$ ) and then group II ( $95.967^\circ \pm 10.4906^\circ$ ) Group (I>III>II) but there was statistical differences between the groups. ( $P=0.050$ ).

**Facial convexity** highest value of ( $22.707^\circ \pm 4.1591^\circ$ ) in Group III, followed by Group II ( $20.740^\circ \pm 4.5665^\circ$ ) and then group I ( $18.813^\circ \pm 6.4215^\circ$ ) Group (III>II>I) but there were statistical differences between the groups. ( $P=0.129$ ).

The value of **Z angle upper lip** was highest in Group I I ( $69.607^\circ \pm 7.5117^\circ$ ), followed by Group I ( $68.993^\circ \pm 7.3144^\circ$ ) and then group III ( $63.547^\circ \pm 6.3138^\circ$ ) Group (II>I>III) but there were statistical differences between the groups. ( $P=0.045$ ).

The value of **Z angle lower lip** was highest in Group II ( $67.053^\circ \pm 9.7348^\circ$ ), followed by Group I ( $66.227^\circ \pm 10.2780^\circ$ ) and then group III ( $58.320^\circ \pm 9.1461^\circ$ ) Group (II>I>III) but there was statistical differences between the groups. ( $P=0.034$ )

**Table 17: Intergroup Comparison of Skeletal, Dental and Soft Tissue Parameters Among Males of Group I, II, III.**

| S.No.                  | PARAMETERS                         | GROUP I VS GROUP II |           |         | GROUP I VS GROUP II |           |         | GROUP II VS GROUP III |           |         |
|------------------------|------------------------------------|---------------------|-----------|---------|---------------------|-----------|---------|-----------------------|-----------|---------|
|                        |                                    | Mean diff           | Std error | P value | Mean diff           | Std error | P value | Mean diff             | Std error | P value |
| SKELETAL PARAMETERS    |                                    |                     |           |         |                     |           |         |                       |           |         |
| 1                      | SNA (in°)                          | -.22333             | 1.3535    | .236    | 2.5867              | 1.3535    | .148    | .3533                 | 1.3535    | .963    |
| 2                      | SNB (in°)                          | .5000               | 1.4953    | .940    | 2.5000              | 1.5953    | .228    | 3.000                 | 1.4953    | .123    |
| 3                      | ANB (in°)                          | -.30333             | .4385     | .000    | .4133               | .4385     | .617    | -.26200               | .4385     | .000    |
| 4                      | N perpendicular to point A(in mm)  | -.33333             | 1.09530   | .950    | .42200              | 1.09530   | .922    | .08867                | 1.09530   | .996    |
| 5                      | N perpendicular to point B (in mm) | 2.5800              | 1.7154    | .299    | 1.3000              | 1.7154    | .731    | 3.8800                | 1.7154    | .073    |
| 6                      | Co- A (in mm)                      | 1.2933              | 3.9170    | .9429   | -.20533             | 3.9170    | .860    | -.7600                | 3.9170    | .979    |
| 7                      | Co- Gn (in mm)                     | 2.1800              | 4.7300    | .890    | -.0800              | 4.7300    | 1.000   | 2.1000                | 4.7300    | .897    |
| 8                      | Mx-Mand diff (in mm)               | .9067               | 1.5516    | .029    | .4200               | 1.5516    | .960    | 1.3267                | 1.5516    | .671    |
| 9                      | Mx Length (in mm)                  | 4.3400              | 2.5373    | .213    | -.39600             | 2.5373    | .274    | .3800                 | 2.5373    | .988    |
| 10                     | Mand Length (in mm)                | 3.0600              | 4.1351    | .741    | .8467               | 4.1351    | .977    | 3.9067                | 4.1351    | .615    |
| 11                     | Mand Plane (in°)                   | -.3267              | 2.1017    | .987    | 3.1800              | 2.1017    | .295    | 2.8533                | 2.1017    | .372    |
| DENTAL PARAMETERS      |                                    |                     |           |         |                     |           |         |                       |           |         |
| 12                     | U1 –NA (in°)                       | -.26400             | 2.3575    | .507    | -.1067              | 2.3575    | .999    | -.27467               | 2.3575    | .480    |
| 13                     | U1-NA (in mm)                      | .4733               | .9742     | .878    | -.10267             | .9742     | .548    | -.5533                | .9742     | .838    |
| 14                     | L1to NB (In°)                      | 3.6867              | 2.0549    | .184    | -.23533             | 2.0549    | .492    | 1.3333                | 2.0549    | .794    |
| 15                     | L1 -NB (in mm)                     | .2067               | .7871     | 0.963   | -.5733              | .7871     | .748    | -.3667                | .7871     | .888    |
| 16                     | AB II OP (in mm)                   | 1.0200              | 1.3515    | .732    | 1.6600              | 1.3515    | .443    | 2.6800                | 1.3515    | .129    |
| SOFT TISSUE PARAMETERS |                                    |                     |           |         |                     |           |         |                       |           |         |
| 17                     | Upper lip Protrusion (in mm)       | -.8733              | .7277     | .460    | -.11000             | .7277     | .296    | -.19733               | .7277     | .026    |
| 18                     | Lower lip protrusion (in mm)       | 1.1267              | 1.0163    | .514    | 1.8000              | 1.0163    | .172    | 2.9867                | 1.0163    | .014    |
| 19                     | Nasolabial angle (in°)             | 8.5200              | 3.3620    | .039    | -.37333             | 3.3620    | .513    | 4.7867                | 3.3620    | .338    |
| 20                     | Facial convexity (in°)             | -.19267             | 1.8784    | .565    | -1.667              | 1.8784    | 0.552   | -.38933               | 1.8784    | .108    |
| 21                     | Z angle upperlip (ino)             | -.6133              | 2.5802    | .969    | 6.0600              | 2.5802    | .060    | 5.4467                | 2.5802    | .100    |
| 22                     | Z angle lower lip(ino)             | -.0267              | 3.5531    | 0.971   | 8.7333              | 3.5531    | .047    | 7.9067                | 3.5531    | .079    |

**P>.05 Non-Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.**

**Table 17 shows: Intergroup Comparison of Skeletal, Dental and Soft Tissue Parameters Among Male of Group I, II, III.**

On inter group comparison between males, for **ANB** ( $p=0.000$ ), statistically significant difference was seen in group I Vs II and I Vs III and where group II verses III did not show statistically significant difference.

**Maxillary-Mandibular differences** values showed statistically significant difference between group I and II ( $P=.029$ ), whereas group II verses III and group I verses III did not show statically significant difference.

For **Upper lip Protrusion** ( $p=0.026$ ), statistically significant difference was found only for group I verses group III whereas group I verses II and group II verses III did not show statistically significant difference.

For **Lower lip Protrusion.**, ( $p=0.014$ ), it was found only for group I verses group III and showed statistically significant difference whereas group I verses II and group II verses III did not show statical significant difference. For **Nasolabial angle**, ( $p=0.039$ ), it was found only for group I verses group II and showed statistically significant difference whereas group.

For **Nasolabial angle**, ( $p=0.039$ ), it was found only for group I verses group II and showed statistically significant difference whereas group II verses III and group I verses III did not show statical significant difference. comparison for **Z Angle Lower lip** ( $p=0.047$ ), significant statistical difference was seen only for group II verses III, I verse III and group II verses III did not show statistically significant difference.

- Skeletal parameter **SNB, SNB, N perpendicular to point A, N perpendicular to point B, Co-A, Co -Gn, Maxillary Length Mandibular Length, Mandibular plane. Dental Parameters, U1-NA, U1-NA, L1-NB, AB II OP and soft tissue parameters, Facial Convexity and Z Angle upper lip** showed non-significant statistical difference for all the Comparison groups.

**Table 18: Intragroup comparison in between Male Vs Female of Group II****(Class II Division 1 Malocclusion)**

| S No                   | PARAMETERS                         | Male(N=15)      | Female (N=15)  | Mean Difference | Std. Error difference | P- Value |
|------------------------|------------------------------------|-----------------|----------------|-----------------|-----------------------|----------|
|                        |                                    | Mean value      | Mean value     |                 |                       |          |
| SKELETAL PARAMETERS    |                                    |                 |                |                 |                       |          |
| 1                      | SNA (in°)                          | 84.807±3.5568   | 84.500±3.1706  | .3067           | 1.2303                | .805     |
| 2                      | SNB (in°)                          | 79.313±4.1639   | 78.500±3.3520  | .8133           | 1.3802                | .560     |
| 3                      | ANB (in°)                          | 5.793±0.8988    | 5.453±1.9131   | .3400           | .5457                 | .538     |
| 4                      | N perpendicular to point A (in mm) | 1.9600±2.04374  | 3.5133±2.24686 | 1.55333         | .78423                | .058     |
| 5                      | N perpendicular to point B (in mm) | -3.920±4.1825   | -3.627±4.5053  | -0.2933         | 1.5873                | .855     |
| 6                      | Co- A (in mm)                      | 80.260±8.001    | 78.067±7.7338  | 2.1933          | 2.8730                | .452     |
| 7                      | Co- Gn (in mm)                     | 102.227±10.9755 | 96.347±8.3634  | 5.8800          | 3.5629                | .110     |
| 8                      | Mx-Mand diff (in mm)               | 21.887±4.7590   | 18.527±4.7423  | 3.3600          | 1.7347                | .063     |
| 9                      | Mx Length (in mm)                  | 47.047±5.4626   | 49.313±3.5916  | 2.2667          | 1.6880                | .190     |
| 10                     | Mand Length (in mm)                | 66.893±8.5220   | 63.653±7.9667  | 3.2400          | 3.0121                | .291     |
| 11                     | Mand Plane (in°)                   | 31.760±5.4806   | 29.840±5.1978  | 1.9200          | 1.9503                | .333     |
| DENTAL PARAMETERS      |                                    |                 |                |                 |                       |          |
| 12                     | U1 –NA (in°)                       | 30.227±5.8159   | 31.607±5.0661  | 1.3800          | 1.9915                | .494     |
| 13                     | U1-NA (in mm)                      | 6.373±2.9339    | 8.024±2.9106   | 1.6467          | 1.0671                | .134     |
| 14                     | L1to NB (In°)                      | 26.227±4.1520   | 29.833±3.4238  | 3.6067          | 1.3895                | .015     |
| 15                     | L1 -NB (in mm)                     | 5.933±1.6990    | 7.100±1.6384   | 1.1667          | .694                  | .066     |
| 16                     | AB II OP (in mm)                   | 4.660±3.1284    | 3.053±2.3068   | 1.6067          | 1.0036                | .121     |
| SOFT TISSUE PARAMETERS |                                    |                 |                |                 |                       |          |
| 17                     | Upper lip Protrusion (in mm)       | 5.827±2.2585    | 6.507±1.1949   | -.6800          | .6597                 | .311     |
| 18                     | Lower lip protrusion (in mm)       | -4.893±2.5415   | -3.727±4.3140  | 1.1667          | 1.2928                | .375     |
| 19                     | Nasolabial angle (in°)             | 95.967±10.4906  | 97.427±9.3796  | 1.4600          | 3.6335                | .691     |
| 20                     | Facial convexity (in°)             | 20.740±4.5665   | 18.727±5.0082  | 2.0133          | 1.7499                | .260     |
| 21                     | Z angle upperlip (ino)             | 69.607±7.5117   | 63.293±5.6449  | 3.3133          | 2.4261                | .183     |
| 22                     | Z angle lower lip(ino)             | 67.053±9.7348   | 62.913±8.5000  | 4.1400          | 3.3368                | .225     |

**P>.05 Non Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.**

**Table 18 shows Intragroup comparison in between Males Vs Females Group II (Class II Division 1 Malocclusion):**

On intergroup comparison between male and female of group II, **L1 to NB(in°)** had higher value for females ( $29.883 \pm 4.4238$ ) than males ( $26.227 \pm 4.1520$ ); ( $P=.015$ ) and showed statistical significant difference.

SNA had higher value for males ( $84.807 \pm 3.5568$ ) than female ( $84.500 \pm 3.1706$ ); ( $P=.805$ ) ; SNB had higher value for males ( $79.313 \pm 4.1639$ ) than females ( $78.500 \pm 3.3520$ ); ( $P=.560$ ); ANB had higher value for male ( $5.793 \pm .8988$ ) than female ( $5.453 \pm 1.9131$ ); ( $P=.538$ ); **N perpendicular to point A** had higher value for females ( $3.5133 \pm 2.24686$ ) than males ( $1.9600 \pm 2.04374$ ); ( $P=.058$ ) ; **N perpendicular to point B** had higher value for females ( $-3.627 \pm 4.5053$ ) than males ( $-3.920 \pm 4.1825$ ); ( $P=.855$ ) ; **Co-A (in mm)** had higher value for males ( $80.260 \pm 8.001$ ) than female ( $78.067 \pm 7.7338$ ); ( $P=.452$ ) ; **Co-Gn (in mm)** had higher value for males ( $102.227 \pm 10.9755$ ) than females ( $96.347 \pm 8.3634$ ); ( $P=.110$ ); **Mx Length (in mm)** had higher value for males ( $47.047 \pm 5.4626$ ) than female ( $49.313 \pm 3.5916$ ); ( $P=.190$ ); **Mand Length (in mm)** had higher value for males ( $66.893 \pm 8.5220$ ) than females ( $63.653 \pm 7.9667$ ); ( $P=.291$ ) .

**Mand Plane (in°)** had higher value for males ( $31.760 \pm 5.4806$ ) than female ( $29.840 \pm 5.1978$ ); ( $P=.333$ ); **U1-NA(in°)** had higher value for females ( $31.607 \pm 5.0661$ ) than males ( $30.227 \pm 5.8159$ ); ( $P=.494$ ). **U1-NA(in mm)** had higher value for females ( $8.024 \pm 2.9106$ ) than male ( $6.373 \pm 2.9339$ ); ( $P=.134$ ). **L1 to NB(in°)** had higher value for female s( $29.883 \pm 3.4238$ ) than male ( $26.227 \pm 4.1520$ ); ( $P=.015$ ); **L1 to NB(in mm)** had higher value for female ( $7.100 \pm 1.6384$ ) than males ( $5.933 \pm 1.6990$ ); ( $P=.066$ ). **ABHIOP (in mm)** had higher value for males ( $4.660 \pm 3.1284$ ) than females ( $3.053 \pm 2.3068$ ); ( $P=.121$ ). **Upper lip protrusion** had higher value for females ( $6.507 \pm 1.1949$ ) than males ( $5.827 \pm 2.2587$ ); ( $P=.311$ ) . **Lower lip protrusion** had higher value for females ( $-3.727 \pm 4.3140$ ) than males ( $-4.893 \pm 2.5415$ ); ( $P=.375$ )

**Nasolabial Angle** had higher value for females ( $97.427 \pm 9.3796$ ) than male ( $95.967 \pm 10.4906$ ); ( $P=.691$ ) . **Facial convexity** had higher value for males ( $20.740 \pm 4.5665$ ) than females ( $18.727 \pm 5.0082$ ); ( $P=.260$ ) . **Z Angle upper lip** had higher value for males ( $69.607 \pm 7.5117$ ) than females ( $63.293 \pm 5.6449$ ); ( $P=.183$ ) . **Z Angle Lower lip** had higher value for males ( $67.053 \pm 9.7348$ ) than females

(62.913±8.5000);(P=.225) however none of the differences were statistically significant between males and females.

The intergroup comparison between males and females individuals with Class II Division 1 Malocclusion reveals several differences and similarities in their skeletal, dental, and soft tissue parameters.

**Table 19: Intragroup comparison between males and Females of Group III****(Class II Division 1 subdivision malocclusion)**

| S<br>No.               | PARAMETERS                         | Male(N=15)     | Female (N=15)  | Mean<br>Difference | Std. Error<br>difference | P-<br>Value |
|------------------------|------------------------------------|----------------|----------------|--------------------|--------------------------|-------------|
|                        |                                    | Mean value     | Mean value     |                    |                          |             |
| SKELETAL PARAMETERS    |                                    |                |                |                    |                          |             |
| 1                      | SNA (in°)                          | 82.220±3.4876  | 83.633±5.120   | -1.4133            | 1.5996                   | .385        |
| 2                      | SNB (in°)                          | 76.813±3.4985  | 78.080±4.9099  | -1.2667            | 1.5566                   | .423        |
| 3                      | ANB (in°)                          | 5.380±1.6054   | 5.687±1.5505   | -.3067             | .5763                    | .599        |
| 4                      | N perpendicular to point A(in mm)  | 1.5380±3.63824 | 3.886±2.70499  | -2.34867           | 1.17058                  | .055        |
| 5                      | N perpendicular to point B (in mm) | -5.220±4.8408  | -1.600±4.2458  | -3.6200            | 1.6625                   | .038        |
| 6                      | Co- A (in mm)                      | 82.313±7.6492  | 75.367±10.0867 | 6.9467             | 3.2685                   | .043        |
| 7                      | Co- Gn (in mm)                     | 102.307±9.3216 | 93.020±12.9408 | 9.2867             | 4.1179                   | .033        |
| 8                      | Mx-Mand diff (in mm)               | 21.467±3.9540  | 17.653±4.9894  | 3.8133             | 1.6437                   | .028        |
| 9                      | Mx Length (in mm)                  | 51.007±5.6349  | 45.813±9.7345  | 5.1933             | 2.9042                   | .085        |
| 10                     | Mand Length (in mm)                | 66.047±8.3668  | 59.687±7.6306  | 6.3600             | 2.9238                   | .038        |
| 11                     | Mand Plane (in°)                   | 28.580±5.5528  | 30.980±5.9198  | -2.4000            | 2.0957                   | .262        |
| DENTAL PARAMETERS      |                                    |                |                |                    |                          |             |
| 12                     | U1 –NA (in°)                       | 30.333±7.5425  | 30.333±7.4099  | .0000              | 2.7300                   | 1.000       |
| 13                     | U1-NA (in mm)                      | 7.400±2.4811   | 6.860±3.5116   | .5400              | 1.1102                   | .630        |
| 14                     | L1to NB (In°)                      | 28.580±4.2859  | 29.627±5.8629  | -1.0467            | 1.8751                   | .581        |
| 15                     | L1 -NB (in mm)                     | 6.507±2.4285   | 6.340±2.4344   | .1667              | .8878                    | .852        |
| 16                     | AB II OP (in mm)                   | 3.000±3.2393   | 2.680±3.5011   | .3200              | 1.2315                   | .797        |
| SOFT TISSUE PARAMETERS |                                    |                |                |                    |                          |             |
| 17                     | Upper lip Protrusion (in mm)       | 6.927±1.8262   | 5.620±1.8190   | 1.3067             | .6655                    | .060        |
| 18                     | Lower lip protrusion (in mm)       | -6.753±2.7368  | -4.613±2.7679  | -2.1400            | 1.0050                   | .042        |
| 19                     | Nasolabial angle (in°)             | 99.700±8.9584  | 98.800±9.4536  | .9000              | 3.3628                   | .791        |
| 20                     | Facial convexity (in°)             | 22.707±4.1591  | 17.147±6.5785  | 5.5600             | 2.0096                   | .011        |
| 21                     | Z angle upperlip (ino)             | 63.547±6.3138  | 68.413±7.0219  | -4.8667            | 2.4382                   | .056        |
| 22                     | Z angle lower lip(ino)             | 58.320±9.1461  | 64.633±11.6865 | -6.3133            | 3.8317                   | .111        |

**P>.05 Non Significant; P<.05 Just Significant; p<.01 Significant; P<.001 Highly Significant.**

**Table 19 shows Intragroup comparison between males and Females of Group III (class II Division 1 subdivision malocclusion):**

On intergroup comparison between males and females **N perpendicular to point B** had higher value for female ( $-1.600 \pm 4.2458$ ) than males ( $-5.220 \pm 4.8408$ ); ( $P=.038$ ). **SNA** had higher value for females ( $83.633 \pm 5.120$ ) than male ( $82.220 \pm 3.4876$ ); ( $P=.385$ ); **(Co-A mm)** had higher value for males ( $8.2313 \pm 7.6492$ ) than females ( $75.367 \pm 10.0867$ ); ( $P=.043$ ); **Co-Gn in mm** had higher value for males ( $102.307 \pm 9.3216$ ) than females ( $93.020 \pm 12.9408$ ); ( $P=.033$ ). **Mand Length (in mm)** had higher value for males ( $66.047 \pm 8.3668$ ) than females ( $59.687 \pm 7.6306$ ); ( $P=.038$ ). **Lower lip protrusion** had higher value for females ( $-4.613 \pm 2.7679$ ) than male ( $-6.753 \pm 2.7368$ ); ( $P=.042$ )

**.Facial convexity** had higher value for males ( $22.707 \pm 4.1591$ ) than females ( $17.147 \pm 6.5785$ ); ( $P=.011$ ) and differences were statistically significant both M>F of Group III other perpendicular **SNB** had higher value for females ( $78.080 \pm 4.9099$ ) than males ( $76.813 \pm 3.4985$ ); ( $P=.423$ ); **ANB** had higher value for females ( $5.687 \pm 1.5505$ ) than males ( $5.380 \pm 1.6054$ ); ( $P=.599$ ); **N perpendicular to point A** had higher value for females ( $3.886 \pm 2.70499$ ) than males ( $1.5380 \pm 3.638254$ ); ( $P=.055$ ); **Mx Length (in mm)** had higher value for males ( $51.007 \pm 5.6349$ ) than females ( $45.813 \pm 9.7345$ ); ( $P=.085$ ); **Mand Plane (in°)** had higher value for females ( $30.980 \pm 5.9198$ ) than males ( $28.580 \pm 5.5528$ ); ( $P=.262$ ); **U1-NA(in°)** had higher value for males ( $30.333 \pm 7.5425$ ) than females ( $30.333 \pm 7.4099$ ); ( $P=.1.000$ ).

**U1-NA(in mm)** had higher value for males ( $7.400 \pm 2.4811$ ) than females ( $6.860 \pm 3.5116$ ); ( $P=.630$ ); **L1 to NB(in°)** had higher value for females ( $29.627 \pm 5.8629$ ) than males ( $28.580 \pm 4.2859$ ); ( $P=.581$ ); **L1 to NB(in mm)** had higher value for males ( $6.507 \pm 2.4285$ ) than females ( $6.340 \pm 2.4344$ ); ( $P=.852$ ).

**ABIIOP (in mm)** had higher value for males ( $3.000 \pm 3.2393$ ) than females ( $2.680 \pm 3.5011$ ); ( $P=.797$ ); **Upper lip protrusion** had higher value for males ( $6.927 \pm 1.8262$ ) than females ( $5.620 \pm 1.8190$ ); ( $P=.060$ ); **Nasolabial Angle** had higher value for males ( $99.700 \pm 8.9584$ ) than females ( $98.800 \pm 9.4536$ ); ( $P=.791$ ); **Z Angle upper lip** had higher value for females ( $68.413 \pm 7.0219$ ) than males ( $63.547 \pm 6.3138$ ); ( $P=.056$ ); **Z Angle Lower lip** had higher value for females ( $64.633 \pm 11.6865$ ) than males ( $58.320 \pm 9.1461$ ); ( $P=.111$ ); however none of the differences were statistically significant difference.

## **DISCUSSION**

Orthodontic diagnosis involves assessment of the face in all three dimensions anteroposterior, vertical and transverse, both clinically and radiographically. The preliminary step for accurate diagnosis is to classify the actual dental occlusion of the patient as Class I, Class II and Class III malocclusion. Amongst these Class II malocclusions is a clinically challenging malocclusion with varied presentation. Class II Division 1 malocclusion presents with proclined upper incisors, increased overjet, deep incisor overbite can occur in the anterior region etc.

In Class II Division 2 malocclusion there is lingual inclination of maxillary central incisors and labial inclination of lateral incisors, or there may be lingual inclination of all the four incisors with canines overriding the lateral incisors, deep bite, trauma to mandibular labial gingival tissues and normal muscle function. Both the divisions may have subdivision where the molar relationship is Class I on one side and Class II on the other side. The presence of subdivision malocclusion possesses additional issues to be resolved while treating a case, especially with class II division 1 malocclusion. Class II subdivision malocclusion are extremely challenging for diagnosis and treatment planning as it is difficult to ascertain the cause of the malocclusion, that is skeletal, dental or combination of both<sup>2</sup>.

The assessment of asymmetries found in Class II malocclusions is important to determine the correct etiology and treatment protocol for the malocclusion. Treatment outcomes of Angle Class I subdivision malocclusions may be compromised because of the uncertainty of the subdivision malocclusion etiology. Amongst primary factors contributing to class II subdivision malocclusion is distal positioning of mandibular 1st molar on class II side, secondary contributor is mesial positioning of a Maxillary first molar on class II side. Therefore, a mandibular dental midline deviation to Class II side is more frequent than maxillary dental midline deviation to opposite side as seen clinically or on posteroanterior radiographs. The other contributors to the origin of this asymmetric malocclusion could be skeletal or functional that have not been widely studied in previous studies.

The deviation in anteroposterior plane as seen in Class II subdivision malocclusion could be seen on lateral cephalometric radiographs without burden of additional radiation exposure or extra cost to patients as they are routinely taken for all subject undergoing fixed orthodontic treatment.

Considering this, it was decided to evaluate the swing of skeletal dental and soft tissue characteristics of Angle's Class II Division 1 subdivision malocclusion towards skeletal Class I or skeletal Class II malocclusions on lateral cephalogram using Nemoceph software.

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences. The sample was collected from patients coming to the department for fixed orthodontic treatment in the age range of 12 to 25 years (mean age  $18.5 \pm 6.5$  years). Also, the sample was selected from old records in the department based on molar relationship as seen on study model.

The sample included pre-treatment Lateral Cephalograms of 90 subjects, divided in three Groups-Group I included 30 subjects with Class I malocclusion (males, n-15, females, n -15) malocclusion, Group II included 30 subjects with Class II Division 1 malocclusion (males, n-15, females,n-15) and Group III included 30 subjects with Class II Division I subdivision malocclusion (males, n -15, females n -15) based on examination of molar relationship clinically or on study models.

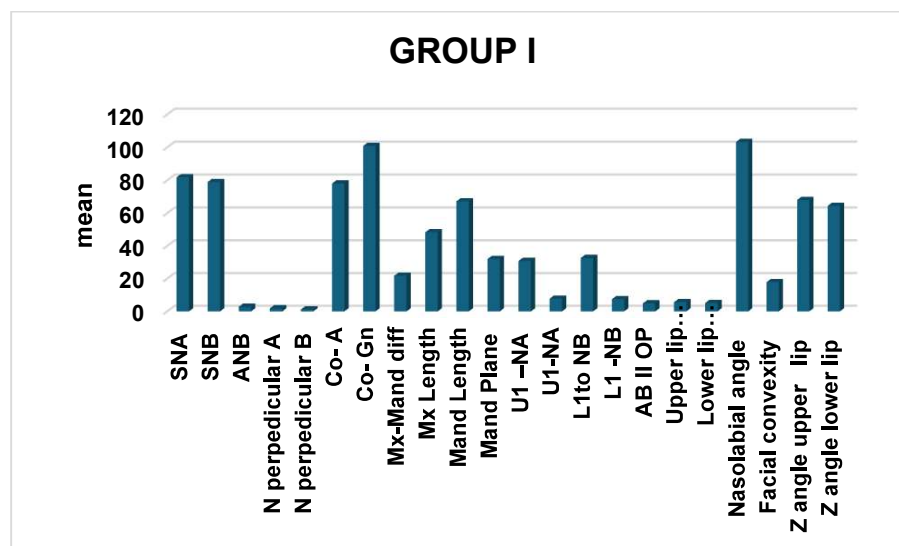
All the cephalograms were taken by same cephalostat machine as per standard protocol in Department of Oral Medicine and Radiology that are transferred to a computer loaded with Planmeca software from where the digital lateral cephalograms were saved in bitmap files and taken in a CD-ROM. These were imported to the Nemoceph software (version 6.0) on Laptop. After calibration of patient lateral cephalogram for automatic correction of magnification error, cephalometric landmarks were identified. The image enhancement features of the software, like brightness, contrast adjustment and magnification are used for accurate identification of landmarks and adjustments of the hard tissue and soft tissue structures.

22 selected parameters (12 linear and 10 angular) from various analysis are measured in all the subjects of different groups Data is tabulated for all the groups and statistical analysis is done by using ANOVA (F-value and P value) and Levene's Test.

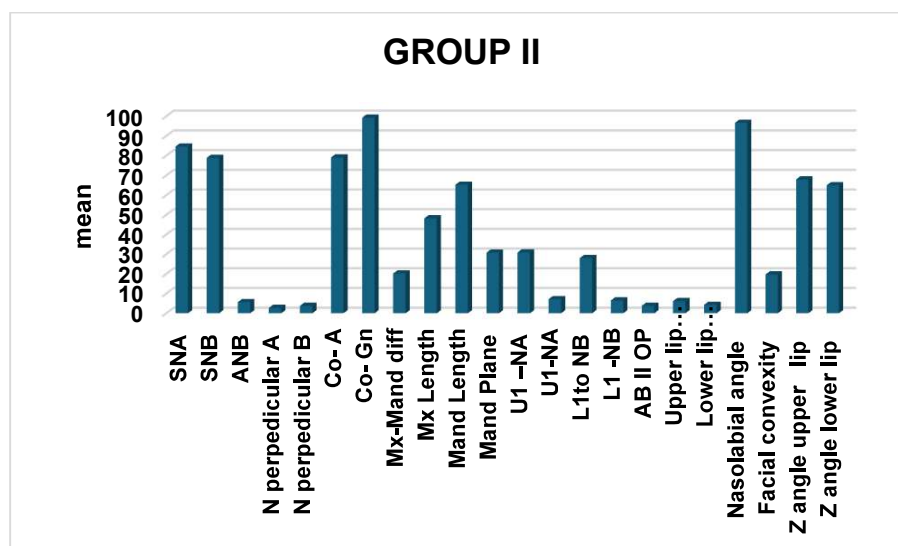
The result of present study did not reveal any definite swing of skeletal characteristics of group III (Class III subdivision) towards group I (Class I) or group II (Class II Division 1) suggestive of the malocclusion is primarily dentoalveolar. The result of the present study are discussed as follows:

### Comparison of Skeletal, Dental and Soft tissue characteristics of overall sample (Male and Female) of group I, II & III.

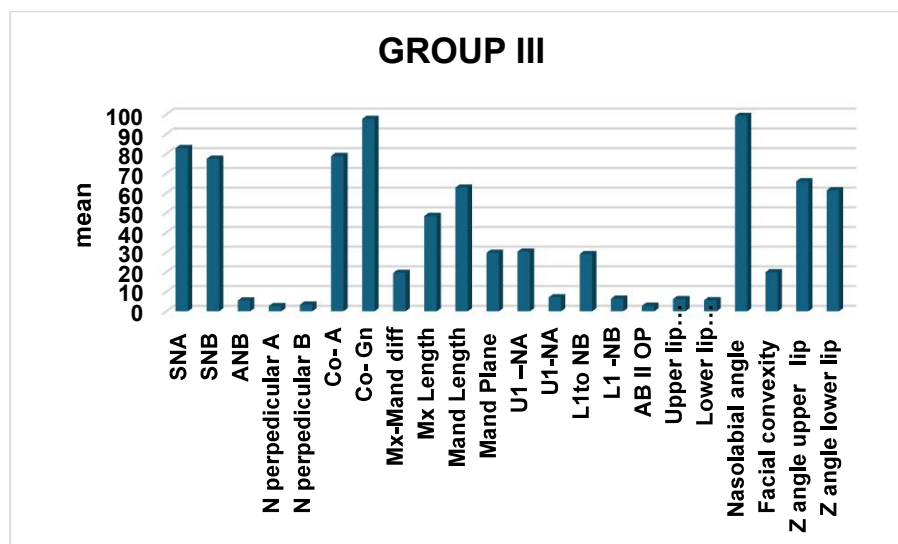
The results of the study for overall sample showed that among all the Skeletal, Dental and Soft tissue parameters, only maxillary position (SNA) angle, maxillary mandibular discrepancy (ANB°); Mandibular incisor inclination (L1-NB) and nasolabial angle had statistically significant difference between the groups. However intergroup comparison showed that group III (Class II Division 1 Subdivision) did not show significant swing of (SNA)angle, (L1-NB°)and nasolabial angle(in°) with either group II or group I. ANB of group III had statistically significant difference with group II and non- significant difference with group I, suggestive of similarities of this skeletal characteristic of ANB with group I. Rest of the parameters which did not show statistically significance differences among different malocclusion groups suggested that subject of Class II subdivision malocclusion can have feature of either of two malocclusion group. On comparing group I and group II, statistically significant difference was seen for SNA (group I>II), ANB (group I>II), L1-NB (group I>II) and nasolabial angle (group I>II). Table-5; Graph 1-6.



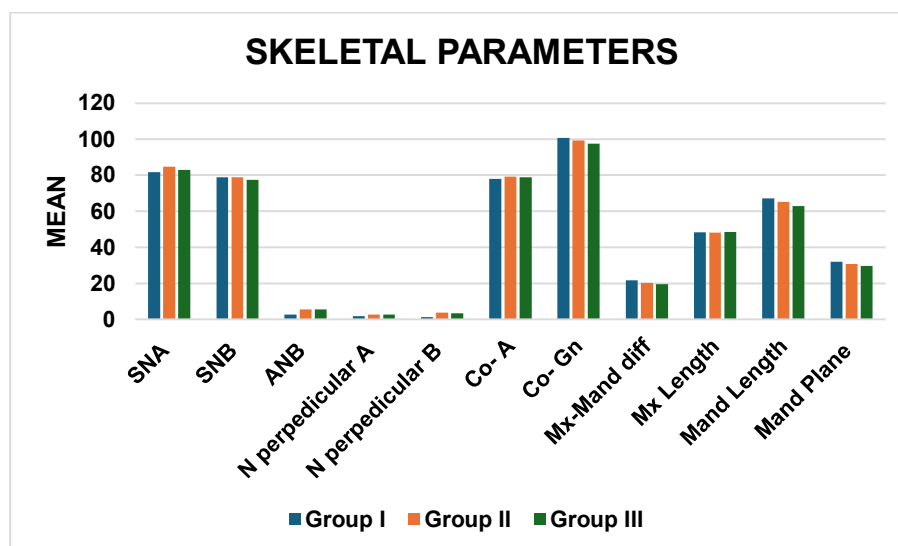
**Graph 1: Descriptive Statistics for Skeletal Dental and soft tissue Parameters of Overall Sample of Group I (Class I Malocclusion)**



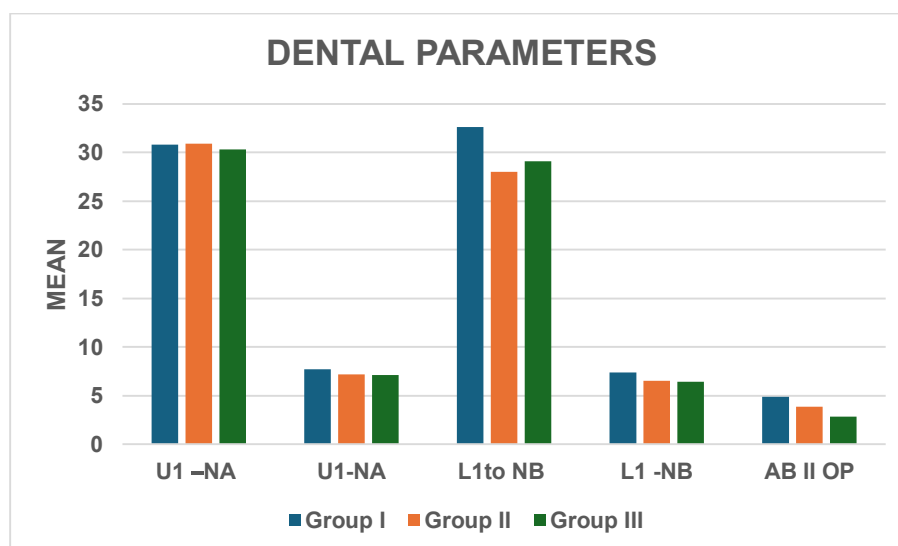
**Graph 2: Descriptive Statistics for Skeletal , Dental and soft tissue Parameters of Overall Sample of Group II (Class II Division 1 Malocclusion)**



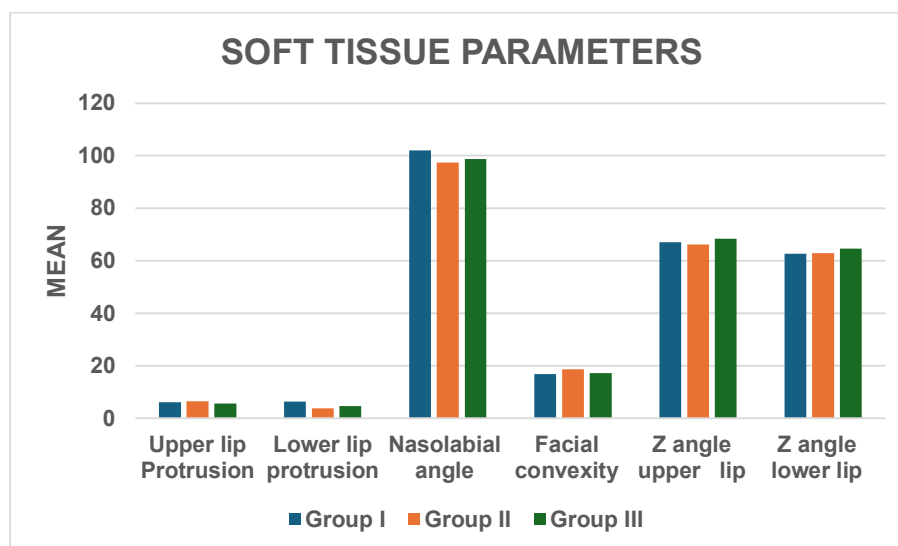
**Graph 3: Descriptive Statistics for Skeletal , Dental and soft tissue Parameters of Overall Sample of Group III (Class II Division 1 Subdivision Malocclusion).**



**Graph 4: Overall Intergroup comparison of Skeletal Parameters of Group I, II & III**



**Graph 5: Overall Intergroup Comparison of Dental Parameters of Group I, II & III.**



**Graph 6: Overall Intergroup Comparison of Soft Tissue Parameters of Group I, II & III.**

The results were compared with previous studies by **Gasgoos et al (2007)**<sup>[27]</sup>, **Meloti et al (2014)**<sup>[18]</sup>, **Hassan et al(2010)**<sup>[32]</sup>, **Freitas et al(2005)**<sup>[25]</sup>, **Thilagarani et al**<sup>[39]</sup>, **Janson**<sup>[3]</sup> where overall sample was considered for comparisons irrespective of gender.

**Gasgoos et al**<sup>[27]</sup> compared three malocclusion group (class I, class II, class III) ; we did not take subject of class III malocclusion in our study, hence result of present study will be compared to difference between Class I and Class II malocclusion of this study. They found statistically significant difference for parameters. Maxillary base length (ANS-PNS) (Class II > Class I) (SNB) (class I > Class II), and for (ANB) ) (Class II > Class I) However ,We found statistically significant difference only for SNA (group II > group I )(.010) and ANB (group II > group I) for overall sample .

**Meloti et al.**<sup>[18]</sup> Compared skeletal and dentoalveolar morphological alterations of subject with Class II subdivision malocclusion (group III) and compared them with Class I(group I) and Class II division 1malocclusion (group II) . Contrary to present study, SNA did not show statistically significant difference. In this study between SNB, L1.GoMe, U1-SN, and NA-Pog showed statistically significant in there study between groups For ANB Angle statistically significant was seen in both the studies with similar trend as group II>group III>group I.

**Hassan et al**<sup>[32]</sup> compared subject with Class II division 1 malocclusion and Class I occlusion groups .Contrary to present study, statistically significant difference was

seen for SNA (group II>I) ( $p=.001$ ) and ANB (group II>group I) ( $p=.000$ ). where as statistically significant difference was seen for L1-NB was seen in present study only.

**Freitas et al**<sup>[25]</sup> compared subjects with Class II Division 1 malocclusion (group 2) and Class I (group 1), found statistically significant difference ( $p<.001$ ) for SNB (group 1>group 2) ; ANB (group 2>group 1) ; N- perpendicular A(mm), (group 2>group 1); N perpendicular B (mm)(group 1>group 2), Co-Gn(mm)(group 2>group 1); SN.GoGn (group 2>group 1) ; U1.NA (group 1>group 2); L1.NB(group 1>group 2). L1 to NB( $in^{\circ}$ )(group 2>group 1) .Similar results were seen in present study for all the ANB and L1-NB (degree) were contrary results were seen for SNA. .For SNB ( $P=.257$ ) ; U1-NA(mm)( $P=.717$ ) , U1-NA( $in^{\circ}$ )( $P=.935$ ), L1 to NB( $in^{\circ}$  mm) ( $P=.302$ ); (Co-Gn mm )( $P=.621$ ), Mandibular Plane( $in^{\circ}$ )( $P=.315$ ), N perpendicular to point A( $P=.401$ ) , N perpendicular to point B ( $P=.063$ ), (Co-A mm )( $P=.914$ ), U1-NA( $in^{\circ}$ )( $P=.935$ ), trend for the difference between groups were same but it was statistically non-significant .

**Thilagarani et al**<sup>[39]</sup> compared the normal occlusion between Class I individuals (group 1) to those in Class II Division I (group 2). The SNA and SNB values followed similar trends as seen in our present study i.e. ( Group 1 > Group 2 ) ; The ANB value, as well as linear measurements of Upper 1 to NA value and Lower 1-NA (mm) showed similar trends as that of our present study. (Group 2> Group 1).

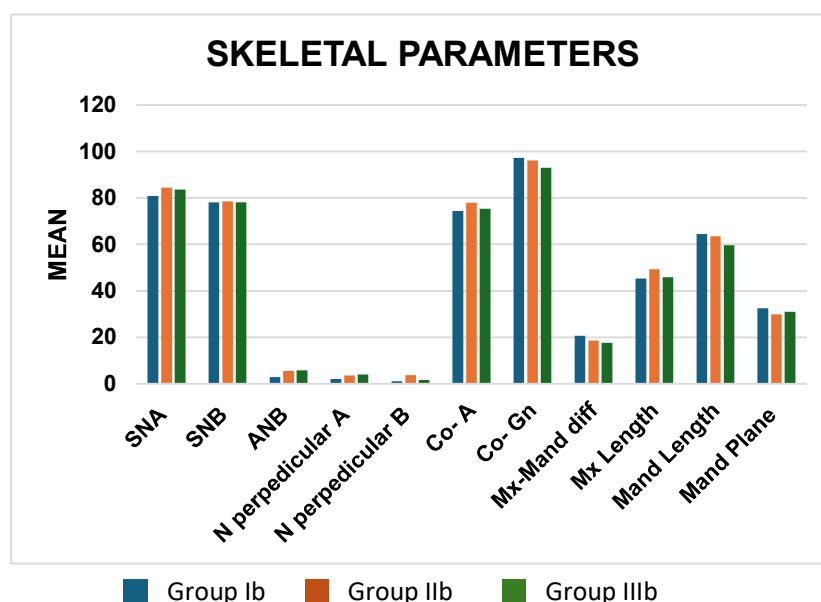
However, the Lower 1 to NB value (in mm) when compared between the two groups (Group 2 > Group 1) was different from our present study present study (Group 1 > Group 2). The values were statistically significant.

**Arshad et al**<sup>[47]</sup> compared the nasal profiles in various skeletal patterns. They found nasolabial angle to be ( $128.333^{\circ} \pm 10.95^{\circ}$ ) in Skeletal Class I subjects , ( $122.14^{\circ} \pm 8.56^{\circ}$ ) in Skeletal Class II subjects with difference being statistically significant ( $p = 0.001$ ). In the present study, the nasolabial angle was found to be markedly lesser for both Class 1 subjects ( $103.260 \pm 7.6432$ ) and Class II subjects ( $96.697 \pm 9.8057$ ). However, the values were not statistically significant ( $p$  value = 0.019).

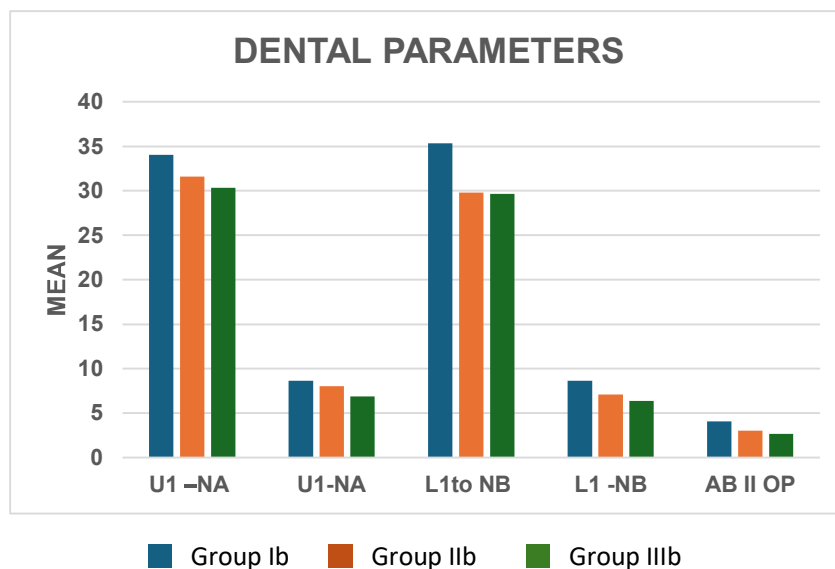
**Janson et al**<sup>[3]</sup> evaluated the asymmetries in subjects with Class II subdivision malocclusion types from posteroanterior radiographs and compared them to that of subjects with normal occlusion. They found that in Normal occlusion (group 1) Z angle was ( $89.90^{\circ} \pm 1.31$ ), and in Class II subdivision malocclusion subjects (group 2) it was ( $90.30^{\circ} \pm 1.40$ ) ( $P$  value = 0.452). This was Suggestive of fact that skeletal asymmetry was not seen in subject with Class II Subdivision malocclusion.

### Comparison of skeletal, Dental and Soft tissue characteristics of female sample of group I, II & III.

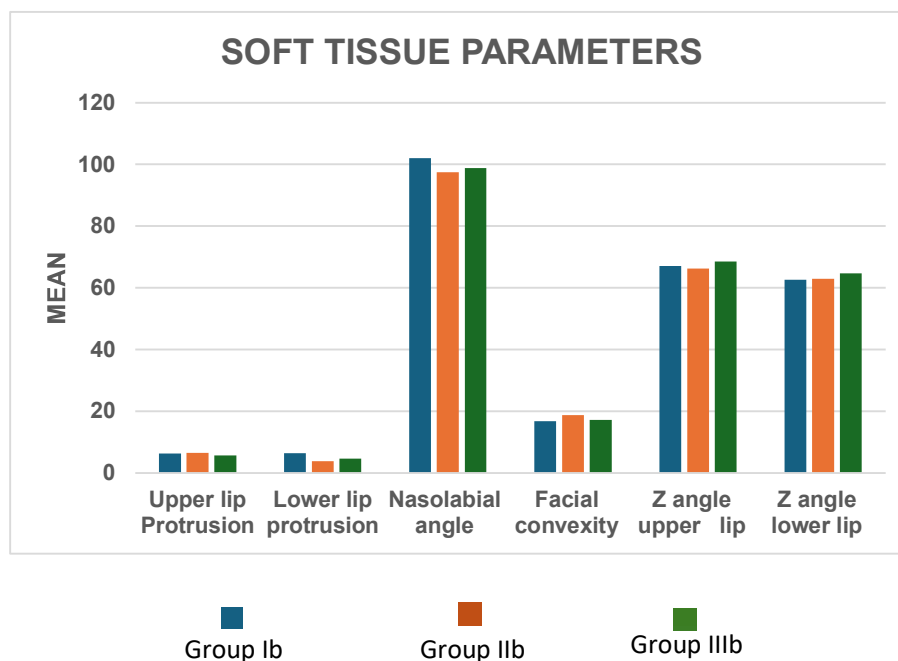
The results of the present study for female sample showed that only maxillary position (SNA) and maxillary -mandibular discrepancy (ANB), showed significant differences between the groups. However intergroup comparison showed that group IIIb (Class II Division 1 subdivision) did not show significant swing of SNA with either group IIb or group Ib. ANB angle had contrasting result from result for overall sample with ANB angle of group IIIb differing significantly with group Ib and non-significant differences with group IIb. This was suggestive of swing of this skeletal characteristic towards group IIb. On comparing group Ib with group IIb statistically significant differences was seen for SNA (IIb>Ib), ANB (group IIb>Ib), Table-10; Graph (7-9)



**Graph 7: Descriptive Statistics for Skeletal Parameters for Females (Group Ib, IIb, IIIb)**



**Graph 8: Descriptive Statistics for Dental Parameters for Females Group (Ib, IIb, IIIb).**



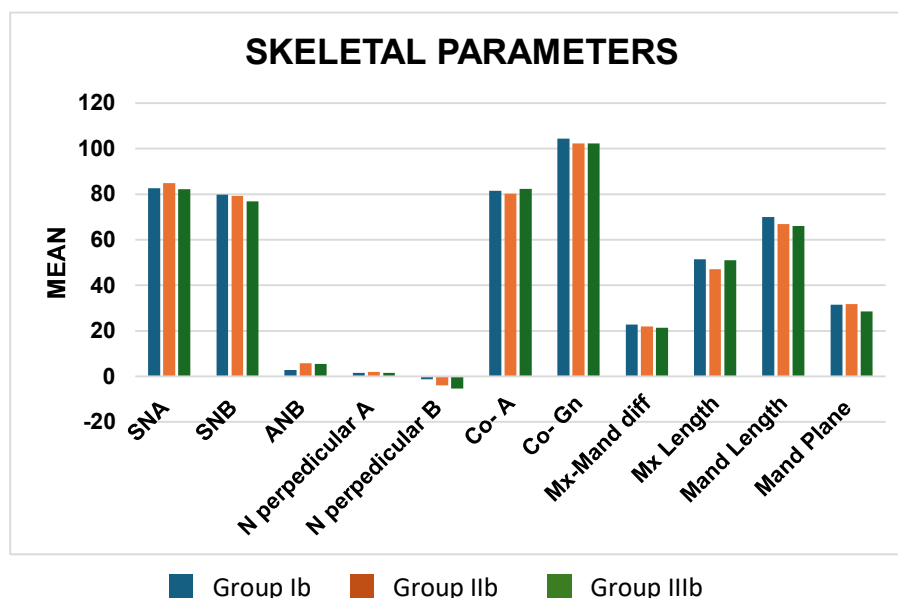
**Graph 9: Descriptive Statistics for Soft Tissue Parameters for Females (Group Ib, IIb, IIIb)**

**Bader A B et al[28]** compared Lithuanian (group 1) and Jordanian (group 2) females having Class II Division 1 malocclusion. The mean SNA angle in group 1 subjects was found to be ( $82.3^{\circ} \pm 3.18^{\circ}$ ) and that in group 2 was found to be ( $82.15^{\circ} \pm 3.15^{\circ}$ ) ( $p$ -value= 0.183) but the difference was statistically non significant. In the present study females of group II ( Class II Division 1 malocclusion) had SNA angle as ( $84.50 \pm 3.170$ ) that was comparatively higher than that seen in the Lithuanian and Jordanian females . They also found ANB Angle for group 1 as ( $5.08^{\circ} \pm 0.81$ ) , ( $4.86^{\circ} \pm 0.94$ ) for group 2 and both the groups had lesser values for ANB angle ( $5.793 \pm 0.898$ ) than present study for group IIb . L1-NB had value of ( $26^{\circ} \pm 5.36$ ) in group 1 and ( $29.85^{\circ} \pm 6.20^{\circ}$ ) in group II ,in their study whereas it was more ( $29.833^{\circ} \pm 3.423^{\circ}$ ) in present study for group IIb,

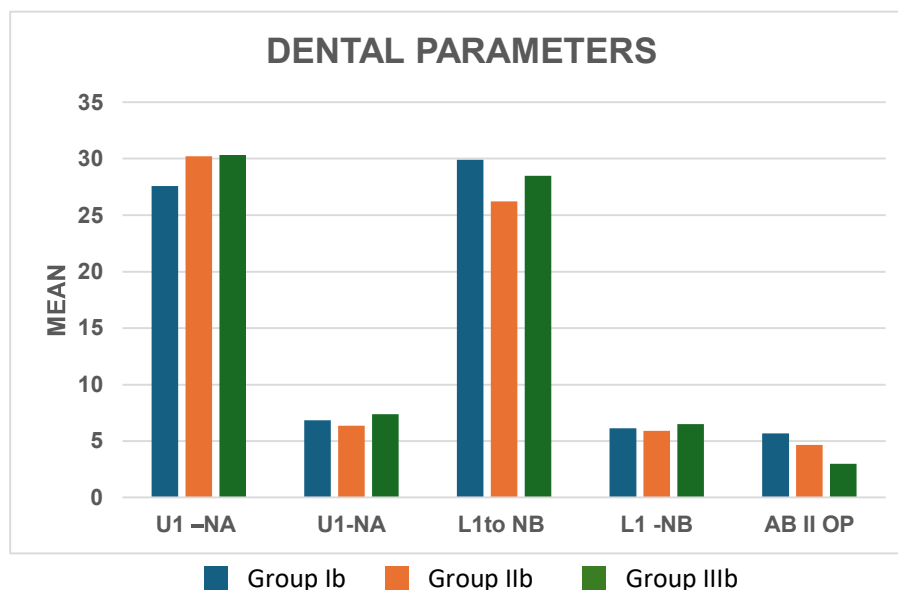
**Dua V et al[48]** evaluated the nasolabial angle in the Indian population and compared it with that of subjects from the Caucasian population group. The Nasolabial Angle was found to be ( $96.1 \pm 9.7^{\circ}$ ), with a mean range of ( $75-115^{\circ}$ ).

#### **Comparison of skeletal, Dental and Soft tissue characteristics of male sample of group I, II & III.**

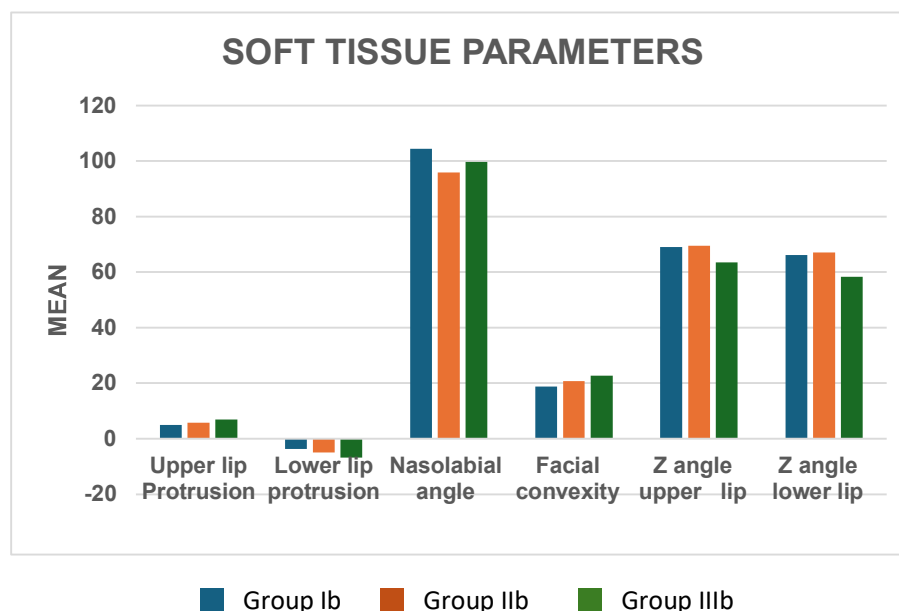
The results of the overall male sample showed that maxillary -mandibular discrepancy (ANB $^{\circ}$ ), Upper lip protrusion, lower lip protrusion, nasolabial angle and Z Angle, Upper lip and lower lip(in $^{\circ}$ ) showed statistically significant difference between the groups. However intergroup comparison showed that for group IIIa (Class II Div 1 Subdivision), ANB angle and upper lip protrusion, differed significantly with group IIa; whereas group IIIa did not showed significant differences with group Ia for ANB, upper and lower lip protrusion, suggestive of similarity between skeletal characteristic (maxillary and mandibular discrepancy and lip protrusion) with group Ia; On contrast Z angle lower lip showed significant difference between group IIIa and group Ia, and non- significant difference between group IIIa and group IIa suggestive of its similarity with group IIa, Nasolabial angle of group IIIa did not show swing towards either group Ia or group IIIa. Rest of parameters On comparing group, Ia with group Ia statistically significant differences was seen for ANB (IIa>Ia), Nasolabial angle group (Ia>IIa) ,Table 15: Graph 10- 12



**Graph 10: Descriptive Statistics of Skeletal Parameters for Males (Group Ia,IIa,IIIa).**



**Graph 11: Descriptive Statistics for Dental Parameters for Males, (Group Ia, IIa, IIIa).**

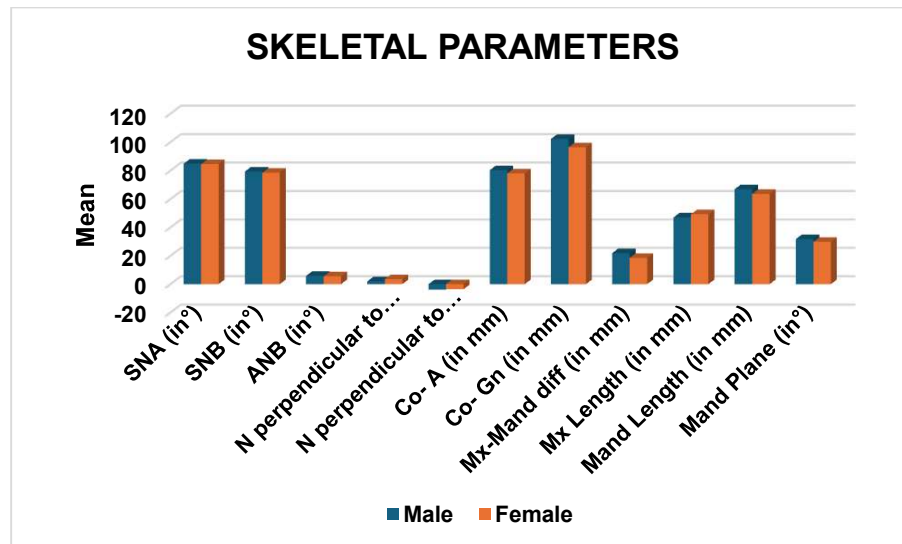


**Graph 12: Descriptive Statistics for Soft Tissue Parameters for Males (Group Ia,IIa,IIIa).**

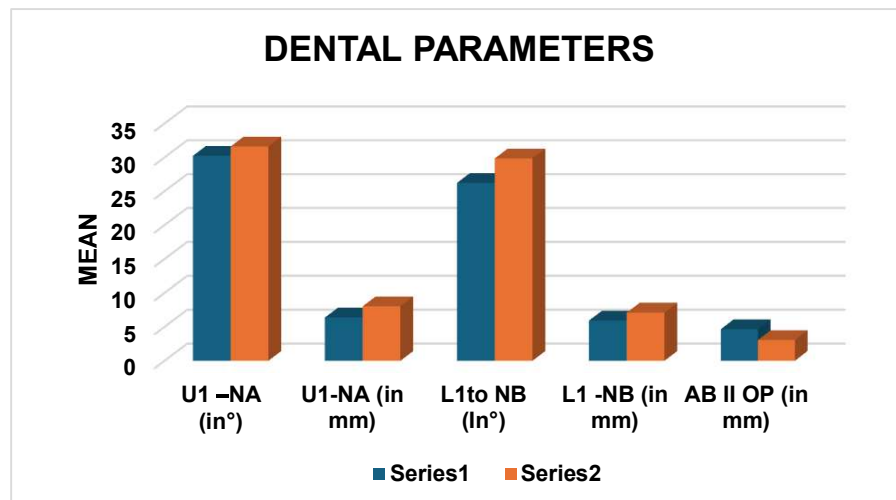
Comparison of skeletal, Dental and Soft tissue characteristics between male and female sample of group II as well as for group III.

For group II, sexual dimorphism was seen only for mandibular incisor inclination (L1-NB) were females(IIb) > than males(IIa). Table 16 , Graph 13-15 In group III, sexual dimorphism was seen for Mandibular position (N perpendicular to point B) with more retrognathic Mandible in female group (IIIb) than males (group IIIa).

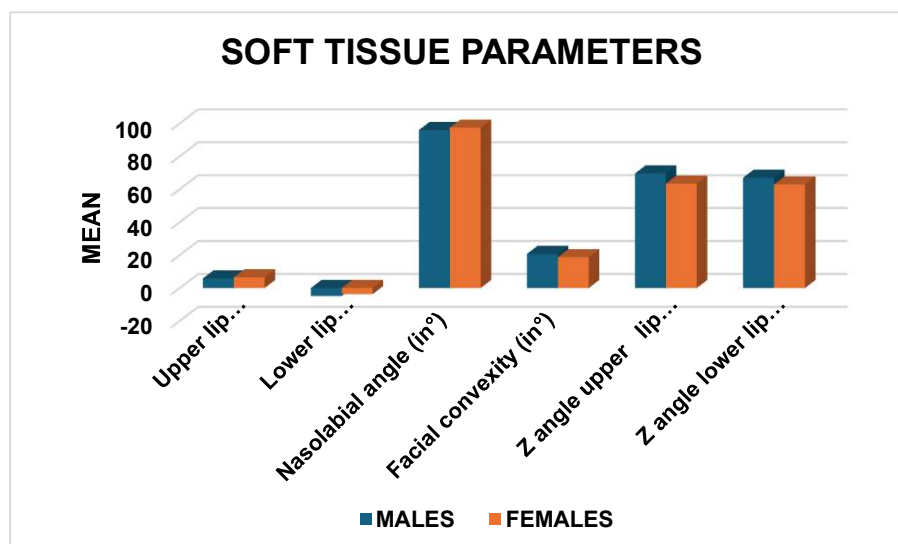
Longer maxilla (Co-A) and longer mandible (Co-Gn) in group IIIa than group IIIb was observed similar trend was found. For Maxillary-mandibular difference, Corpus length, facial convexity. However lower lips were more protrusive in group IIIb than group IIIa. (Table 16 ; Graph-14-17).



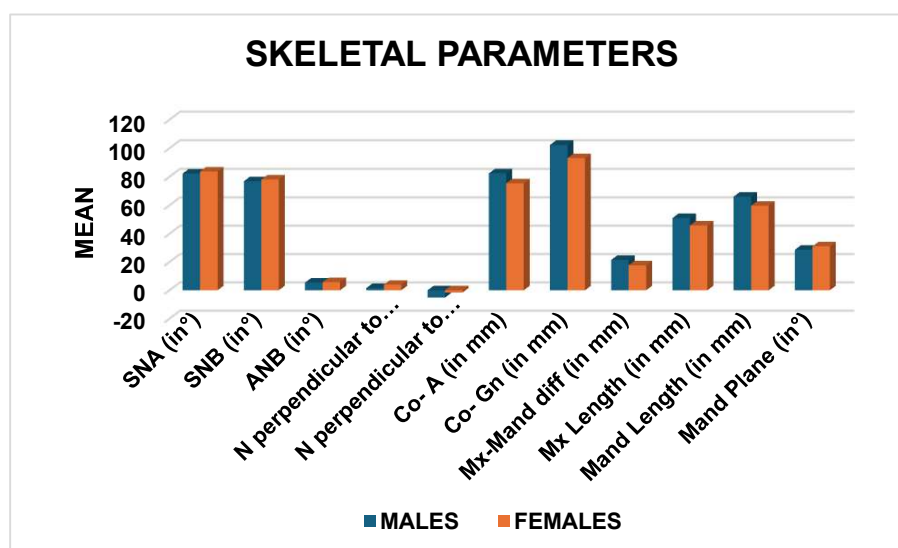
Graph 13: Intragroup Comparison of Skeletal Parameters (Group IIa & IIb).



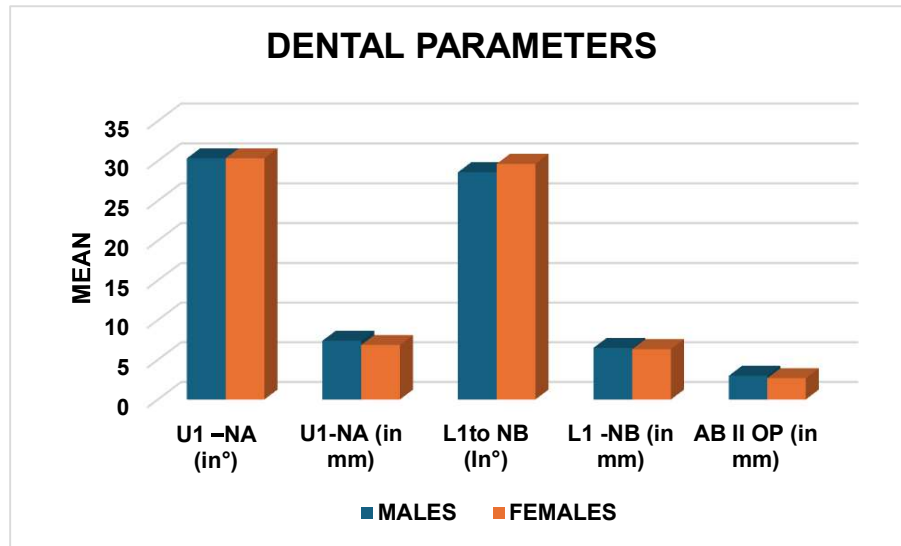
Graph 14: Intragroup Comparison of Dental Parameters (Group IIa & IIb ).



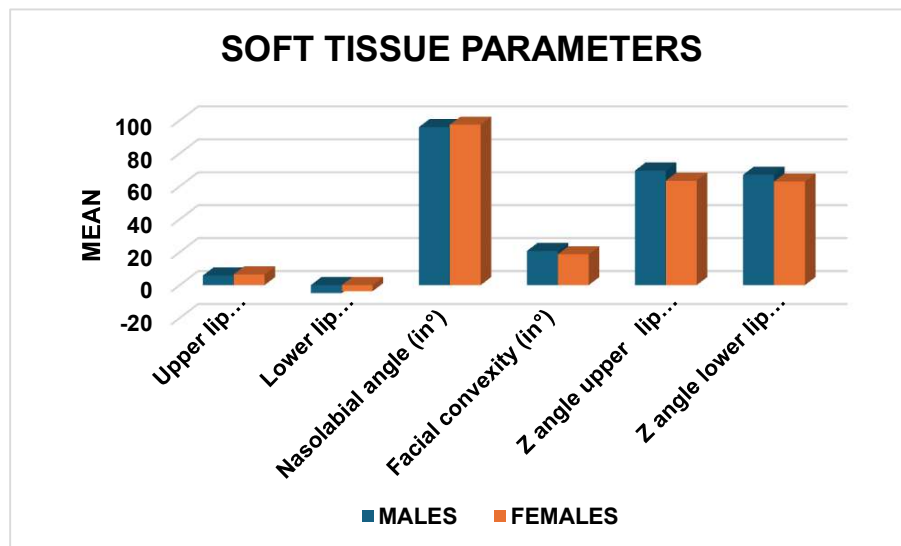
Graph 15: Intragroup Comparison of Soft tissue Parameters (Group IIa & IIb).



Graph 16: Intragroup Comparison of Skeletal Parameters (Group IIIa & IIIb).



Graph 17: Intragroup Comparison of Dental Parameters (Group IIIa & IIIb).



Graph 18: Intragroup Comparison of Soft tissue Parameters (Group IIIa & IIIb).

Many studies done in different population groups attempted to compare dentoskeletal parameters between males and females of Class II division 1 malocclusion to find out sexual dimorphism.

**Sharma et al**<sup>[49]</sup> compared male and female of Chinese population with Class II Division 1 malocclusion. Contrary to present study, L1-NB Angular value showed statistically non-significant differences in there study with values in males as ( $32.33 \pm 8.478^\circ$ ) > female with values as ( $30.074 \pm 7.179^\circ$ ) whereas statistically significant differences seen in present study with females having higher values ( $29^\circ$ ) than males ( $26.2^\circ$ ) for other parameter difference was statistically non-significant differences in both studies with similar treand for SNA(male>female),SNB (male >female),ANB (male>female), Mandibular plane angle (GoGn - SN) (male>female) , L1-NB linear value(male>female) and oppsite trend for U1-NA angle (female>male), L1-NB linear value (female>male),Z angle (female>male) .

**Freitas et al**<sup>[25]</sup> compared male and female of Class II Division I malocclusion. and found statisticaly significant difference only for ANB (female>male), However in the present study only L1-NB (degree) showed statistically significant differences (female>male).

The Mandibular plane angle in Chinese males exhibited a significantly larger angle compared to that of females (p value = 0.041)<sup>[50]</sup>. In Class II division 1 malocclusion the present study, showed a similar trend with males having a larger angle as compared to that of females but difference was statistically non-significant. (p value – 0.333). Also, the values for parameters SNA angle , SNB angle, ANB angle, U1-NA angular, U1-NA Linear, L1-NB Angular, and L1-NB Linear showed no statistically significant differences on gender comparison in both studies, except the L1-NB angular value, which showed statistically significant (0.015) in present study (Female>male).

**Arshad et al**<sup>[47]</sup> compared nasolabial angle between males ( $100.55 \pm 14.52$ ) and females ( $98.87 \pm 15.76$ ),found no statistical significant difference (p value = 0.58). Similar to this, in the present study for Class II Division I Malocclusion , males ( $95.967 \pm 10.4906$ ) and females ( $97.427 \pm 9.3796$ ) did not show statistically significant differences for nasolabial angle and ANB .Similar findings were seen by finding were by **Dua et al**<sup>[48]</sup> for Indian population by **Hwang et al**<sup>[52]</sup> for Korean and European-American adults .

Based on the results of the present study it can be stated that Class II subdivision malocclusion did not show any significant swing for skeletal parameters towards Class II Division 1 Malocclusion or Class I malocclusion rather cephalometric findings suggested that this Malocclusion was more dentoalveolar in nature .The main clinical implication of the study is that management of Class II subdivision malocclusion must focus on correcting dentoalveolar malrelation like maxilla-mandible, midline deviation, correction of molar relation in Class II side, maintenance of molar relation on Class I side, attaining Class 1 canine relationship with proper overjet and overbite.

The major limitation of the present study was that sample was divided on the basis of dental malocclusion as given by Angle. The results of the present study can be validated on larger sample size ,or comparison between different malocclusion groups can be done on basis of skeleton classification of malocclusion .Also dental asymmetry can be evaluated along with skeletal asymmetry in subjects with class II subdivision malocclusion.

## CONCLUSION

Following conclusions are drawn from present study conducted with on aim to evaluate the swing of skeletal, dental and soft tissue characteristics of Angle's Class II Division 1 subdivision malocclusion towards Class I and Class II Division I malocclusion on lateral Cephalogram using Nemoceph software.

1-For Overall sample most of the parameters of subject with Class II subdivision malocclusion showed statistically non-significant differences with other comparison groups, suggestive of the fact that Class II subdivision malocclusion can have dentoskeletal features of either of the two malocclusion groups .Few parameters SNA; L1-NB°and nasolabial angle that showed statistically significant differences among the groups, did not shown significant differences on individual intergroup comparision except ANB.

2-For female sample most of the parameters of subject with Class II subdivision malocclusion show statistically non significant differences with other comparision groups, suggestive of the fact that Class II subdivision malocclusion can have feature of either of the two malocclusion groups .Few parameters like SNA, ANB showed statistically significant differences among this groups,

3-For male except ANB ,Upper and Lower lip protrusion most of the parameters of subject with Class II subdivision malocclusion show statistically non significant differences with other comparision groups, suggestive of the fact that Class II subdivision malocclusion can have feature of either of the two malocclusion groups.

4- For subject with Class II Division 1 subdivision malocclusion statistically significant differences among male and female was seen for N perpendicular to point B(F>M); Effective Maxillary length (F>M);Effective Mandibular length (M>F); Lower Lip Protrusion(M > F) and Facial convexity(M > F ).

Overall Conclusion of the present study suggested that Class II Subdivision malocclusion did not show any significant swing for skeletal parameters towards Class II Division 1 or Class I malocclusion rather cephalometric findings suggested that this malocclusion was dentoalveolar in nature.

## **SUMMARY**

Orthodontic diagnosis involves assessment of the face in all three dimensions anteroposterior, vertical and transverse, both clinically and radiographically. The preliminary step for accurate diagnosis is to classify the actual dental occlusion of the patient as Class I, Class II and Class III malocclusion. Amongst these Class II malocclusions is a clinically challenging malocclusion with varied presentation. Amongst primary factors contributing to Class II subdivision malocclusion is distal positioning of mandibular 1st molar on Class II side, secondary contributor is mesial positioning of a Maxillary first molar on Class II side.

Class II subdivision malocclusion are extremely challenging for diagnosis and treatment planning as its difficult to ascertain the cause of the malocclusion, that is skeletal, dental or combination of both.

Considering this, it was decided to evaluate the swing of skeletal dental and soft tissue characteristics of Angle's Class II Division 1 subdivision malocclusion towards skeletal Class I or skeletal Class II malocclusions on lateral cephalogram using Nemoceph software.

The present study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences, The sample was collected from patients coming to the department for fixed orthodontic treatment in the age range of 18 to 25 years (mean age  $23.5 \pm 2.5$  years). Also, the sample was selected from old records in the department based on molar relationship as seen on study model.

The sample included pre-treatment Lateral Cephalograms of 90 subjects, divided in three Groups-Group I included 30 subjects with Class I malocclusion (males, n-15, females, n-15) malocclusion, Group II included 30 subjects with Class II Division 1 malocclusion (males, n-15, females,n-15) and Group III included 30 subjects with Class II Division I subdivision malocclusion (males, n -15, females n -15) based on examination of molar relationship clinically, or on study models.

All the cephalograms were taken by same cephalostat machine as per standard protocol in Department of Oral Medicine and Radiology that are transferred to a computer loaded with Planmeca software from where the digital lateral cephalograms were saved in bitmap files and taken in a CD-ROM. These were imported to the Nemoceph software (version 6.0) on Laptop. after calibration of patient lateral cephalogram for automatic correction of magnification error Cephalometric landmarks were identified. The image enhancement features of the software, like brightness, contrast adjustment and magnification are used

for accurate identification of landmarks and adjustments of the hard tissue and soft tissue structures.

22 selected parameters ( 12 linear and 10 angular) from various analysis are measured. Was in all the subjects of different groups, Data was tabulated for all the groups and statistical analysis was done by using ANOVA (F-value and P value) and Levene's Test. Following conclusions are drawn from present study conducted with an aim to evaluate the swing of skeletal, dental and soft tissue characteristics of Angle's Class II Division 1 subdivision malocclusion towards Class I and Class II Division 1 malocclusion on lateral cephalogram using Nemoceph software.

1-For Overall sample most of the parameters of subject with Class II subdivision malocclusion showed statistically non significant differences with other comparison groups, suggestive of the fact that Class II subdivision malocclusion can have dentoskeletal features of either of the two malocclusion groups. Few parameters SNA; LI-NB and nasolabial angle that showed statistically significant differences among the groups, did not show significant differences on individual intergroup comparison except ANB.

2-For female sample most of the parameters of subject with Class II subdivision malocclusion showed statistically non significant differences with other comparison groups, suggestive of the fact that Class II subdivision malocclusion can have feature of either of the two malocclusion groups. Few parameters like SNA, ANB, showed statistically significant differences among these groups,

3-For male except ANB, Upper and Lower lip protrusion most of the parameters of subject with Class II subdivision malocclusion showed statistically non significant differences with other comparison groups, suggestive of the fact that Class II subdivision malocclusion can have feature of either of the two malocclusion groups.

4- For subject with Class II Division 1 subdivision malocclusion statistically significant differences among male and female were seen for N perpendicular to point B(F>M); Effective Maxillary length (F>M); Effective Mandibular length (M>F); Lower Lip Protrusion(M> F) and Facial convexity(M > F).

Overall Conclusion of the present study suggested that Class II Subdivision malocclusion did not show any significant swing for skeletal parameters towards Class II Division 1 or Class I malocclusion rather cephalometric findings suggested that this malocclusion was dentoalveolar in nature.

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**APPENDIX -1: INSTITUTIONAL REASEACH COMMITTEE  
APPROVAL**

**BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES  
(FACULTY OF BBD UNIVERSITY), LUCKNOW**

**INSTITUTIONAL RESEARCH COMMITTEE APPROVAL**

The project titled **Cephalometric evaluation of skeletal characteristics of angles class-II Divison-I subdivision Malocclusion as compared to Angles Class-I and Class-II Division-I Malocclusion** submitted by **Dr.Vaishali Kushwaha** Post graduate student from the Department of **Orthodontics and Dentofacial Orthopedics** as part of MDS Curriculum for the academic year 2015-2018 with the Accompanying proforma was reviewed by the institutional research committee present on **23<sup>rd</sup> and 24<sup>th</sup> February 2016** at BBDCODS. The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the institutional ethics committee for granting ethical approval.

**Prof. (Dr.) Vivek Govila**

Dean

Chairperson Institutional Research Committee

## APPENDIX-2: ETHICAL COMMITTEE APPROVAL

**Babu Banarasi Das University**  
**Babu Banarasi Das College of Dental Sciences,**  
**BBD City, Faizabad Road, Lucknow – 226028 (INDIA)**

**Dr. Lakshmi Bala**  
 Professor and Head Biochemistry and  
 Member-Secretary, Institutional Ethics Committee

**Communication of the Decision of the IIIrd Institutional Ethics Sub - Committee**

**IEC Code: 23** **BBDCODS/03/2016**

**Title of the Project:** Cephalometric Evaluation of skeletal characteristics of angle's class II division I Subdivision Malocclusion as compared to angle's class I and angle's class II division I Malocclusion.

**Principal Investigator:** Dr. Vaishali Kushawaha **Department:** Orthodontics & Dentofacial Orthopedics

**Name and Address of the Institution:** BBD College of Dental Sciences Lucknow.

**Type of Submission:** New, MDS Project Protocol

Dear Dr. Vaishali Kushawaha,

The Institutional Ethics Sub- Committee meeting comprising following four members was held on 03<sup>rd</sup> May, 2016.

|    |                                      |                                                                   |
|----|--------------------------------------|-------------------------------------------------------------------|
| 1. | Dr. Lakshmi Bala<br>Member Secretary | Prof. and Head, Department of Biochemistry, BBDCODS,<br>Lucknow   |
| 2. | Dr. Narendra Kumar Gupta<br>Member   | Prof., Department of Prosthodontics, BBDCODS,<br>Lucknow          |
| 3. | Dr. Smita Govila<br>Member           | Reader, Department of Conservative Dentistry,<br>BBDCODS, Lucknow |
| 4. | Dr. Subhash Singh                    | Reader, Department of Pedodontics, BBDCODS,<br>Lucknow            |

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.  
 The proposal was reviewed, comments were communicated to PI thereafter it was revised.

**Decisions: The committee approved the above protocol from ethics point of view.**

Forwarded by:

*Lakshmi Bala 26/05/16*

**(Dr. Lakshmi Bala)**  
 Member-Secretary  
 IEC

*[Signature]*

**(Dr. Vivek Govila)**  
 PRINCIPAL  
 Babu Banarasi Das College of Dental Sciences  
 (Babu Banarasi Das University)  
 BBD City, Faizabad Road, Lucknow-226028

### **APPENDIX-3: CONSENT FORM-ENGLISH**

**Babu Banarasi Das College of Dental Sciences  
(Babu Banarasi Das University)  
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

Guidelines for Devising a Participant / Legally Acceptable Representative Information  
Document 8(PID) in English

**Study Title**

CEPHALOMETRIC EVALUATION OF SKELETAL CHARACTERISTIC OF  
ANGLE'S CLASS II DIVISION I SUBDIVISION MALOCCLUSION AS  
COMPARED TO ANGLE'S CLASS I AND ANGLE'S CLASS II DIVISION I  
MALOCCLUSION.

**Invitation Paragraph**

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research/study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

**What is the purpose of the study?**

the purpose of the study is to to evaluate the effect of arch width and tooth characteristics on perception of smile in subjects with gratifying and non-gratifying smile as rated by panel of judges

**Why have I been chosen?**

No patient is required as it is an in vitro study

**Do I have to take part?**

Not applicable.

**What will happen to me if I take part?**

Not applicable.

**What do I have to do?**

Not applicable

**What is the procedure that is being tested?**

The procedure will involve evaluation of the effect of arch width and tooth characteristics on perception of smile in subjects with gratifying and non-gratifying smile as rated by panel of judges

**What are the interventions for the study?**

To rate the frontal photographs by a panel of judges to divide the group in gratifying and non-gratifying group.

To rate the lower third smiling photographs by a panel of judges to divide the group in gratifying and non- gratifying group

To evaluate micro and mini aesthetic characteristics in subjects with gratifying and non-gratifying subjects.

To compare various characteristics of smile aesthetics between the gratifying and non-gratifying subjects.

To compare various characteristics of smile aesthetics between the gratifying and non-gratifying male and female subjects.

**What are the side effects of taking part?**

Not applicable

**What are the possible disadvantages and risks of taking part?**

Not applicable

**What are the possible benefits of taking part?**

Not applicable

**What if new information becomes available?**

Sometimes during the course of a research project, new information becomes available about the research being studied. If this happens, your researcher will tell you about it and discuss with you whether you want to continue in the study. If you decide to withdraw, your researcher/investigator will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

**What happens when the research study stops?**

If the study stops/finishes before the stipulated time, this will be explained to the patient/volunteer.

**What if something goes wrong?**

If any severe adverse event occurs, or something goes wrong during the study, the

complaints will be handled by reporting to the institution (s), and Institutional ethical community.

**Will my taking part in this study be kept confidential?**

Yes.

**What will happen to the results of the research study?**

The results of the study will be used to be compare features of smile aesthetics in gratifying and non-gratifying subjects.

**Who is organizing the research?**

This research study is organized by the academic institution (BBDCODS).

**Will the results of the study be made available after study is over?**

Yes

**Who has reviewed the study?**

The study has been reviewed and approved by the Head of the Dept, and the IEC/IRC of the institution.

Contact for further information

**Dr. Vaishali Kushawaha**

Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi College of  
Dental Sciences.

Lucknow-227105 Mob- 6394780893

**Dr. Shantanu Khattri (HOD)**

Department of Orthodontics and Dentofacial Orthopaedics Babu Banarasi College of  
Dental Sciences.

Lucknow-227105 Mob-9936424084

Signature of PI.....

Name.....

Date.....

**APPENDIX-4: CONSENT-HINDI**

**Babu Banarasi Das College of Dental Sciences (Babu Banarasi Das University,  
Lucknow)**

**BBD City, Faizabad Road, Lucknow – 227105 (INDIA)**

प्रतिभागी/कानूनी रूप से स्वीकार्य प्रतिनिधि सूचना दस्तावेज़ 8(PID) तैयार करने के लिए दिशा-निर्देश अंग्रेजी में

**अध्ययन का शीर्षक**

एंगल के वर्ग II डिवीजन I उपविभाग मैलोक्ल्यूजन की कंकाल विशेषताओं का सेफालोमेट्रिक मूल्यांकन, एंगल के वर्ग I और एंगल के वर्ग II डिवीजन I मैलोक्ल्यूजन की तुलना में।

**आमंत्रण पैराग्राफ**

आपको एक शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जा रहा है। निर्णय लेने से पहले आपके लिए यह समझना महत्वपूर्ण है कि शोध/अध्ययन क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया निम्नलिखित जानकारी को ध्यान से पढ़ने के लिए समय निकालें और यदि आप चाहें तो दोस्तों, रिश्तेदारों और अपने उपचार करने वाले चिकित्सक/पारिवारिक चिकित्सक से इस पर चर्चा करें। हमसे पूछें कि क्या कुछ ऐसा है जो स्पष्ट नहीं है या यदि आप अधिक जानकारी चाहते हैं। यह तय करने के लिए समय निकालें कि आप भाग लेना चाहते हैं या नहीं।

**अध्ययन का उद्देश्य क्या है?**

अध्ययन का उद्देश्य न्यायाधीशों के पैनल द्वारा मूल्यांकन किए गए संतुष्टिदायक और गैर-संतुष्टिदायक मुस्कान वाले विषयों में मुस्कान की धारणा पर आर्च की चौड़ाई और दाँत की विशेषताओं के प्रभाव का मूल्यांकन करना है।

**मुझे क्यों चुना गया है?**

इन विट्रो अध्ययन होने के कारण किसी मरीज की आवश्यकता नहीं है

**क्या मुझे भाग लेना होगा?**

लागू नहीं।

**अगर मैं भाग लूँ तो मेरा क्या होगा?**

लागू नहीं। मुझे क्या करना होगा?

लागू नहीं

### **किस प्रक्रिया का परीक्षण किया जा रहा है?**

इस प्रक्रिया में न्यायाधीशों के पैनल द्वारा मूल्यांकन किए गए संतुष्टिदायक और गैर-संतुष्टिदायक मुस्कान वाले विषयों में मुस्कान की धारणा पर आर्च की चौड़ाई और दाँत की विशेषताओं के प्रभाव का मूल्यांकन शामिल होगा।

### **अध्ययन के लिए हस्तक्षेप क्या हैं?**

समूह को संतुष्टिदायक और गैर-संतुष्टिदायक समूह में विभाजित करने के लिए न्यायाधीशों के पैनल द्वारा सामने की तस्वीरों को रेट करना।

समूह को संतुष्टिदायक और गैर-संतुष्टिदायक समूह में विभाजित करने के लिए न्यायाधीशों के पैनल द्वारा निचले तीसरे मुस्कुराते हुए फ़ोटो को रेट करना।

संतुष्टिदायक और गैर-संतुष्टिदायक विषयों में सूक्ष्म और लघु सौंदर्य विशेषताओं का मूल्यांकन करना।

संतुष्टिदायक और गैर-संतुष्टिदायक विषयों के बीच मुस्कान सौंदर्यशास्त्र की विभिन्न विशेषताओं की तुलना करना।

संतुष्टिदायक और गैर-संतुष्टिदायक पुरुष और महिला विषयों के बीच मुस्कान सौंदर्यशास्त्र की विभिन्न विशेषताओं की तुलना करना।

### **भाग लेने के क्या दुष्प्रभाव हैं?**

लागू नहीं

### **भाग लेने के संभावित नुकसान और जोखिम क्या हैं?**

लागू नहीं

### **भाग लेने के संभावित लाभ क्या हैं?**

लागू नहीं

### **क्या होगा यदि नई जानकारी उपलब्ध हो जाए?**

कभी-कभी किसी शोध परियोजना के दौरान, अध्ययन किए जा रहे शोध के बारे में नई जानकारी उपलब्ध हो जाती है। यदि ऐसा होता है, तो आपका शोधकर्ता आपको इसके बारे में बताएगा और आपसे चर्चा करेगा कि क्या आप अध्ययन में बने रहना चाहते हैं। यदि आप वापस लेने का निर्णय लेते हैं, तो आपका शोधकर्ता/अन्वेषक आपके वापस लेने की व्यवस्था करेगा। यदि आप अध्ययन में बने रहने का निर्णय लेते हैं, तो आपसे एक अद्यतन सहमति फ़ॉर्म पर हस्ताक्षर करने के लिए कहा जा सकता है।

### **जब शोध अध्ययन बंद हो जाता है तो क्या होता है?**

यदि अध्ययन निर्धारित समय से पहले बंद हो जाता है/समाप्त हो जाता है, तो रोगी/स्वयंसेवक को इसकी व्याख्या की जाएगी।

### **क्या होगा यदि कुछ गलत हो जाता है?**

यदि अध्ययन के दौरान कोई गंभीर प्रतिकूल घटना होती है या कुछ गलत होता है, तो शिकायतों को संस्थान (संस्थाओं) और संस्थागत नैतिक समुदाय को रिपोर्ट करके निपटाया जाएगा। क्या इस अध्ययन में मेरी भागीदारी गोपनीय रखी जाएगी? हां। शोध अध्ययन के परिणामों का क्या होगा? अध्ययन के परिणामों का उपयोग संतुष्टिदायक और गैर-संतुष्टिदायक विषयों में मुस्कान सौंदर्यशास्त्र की विशेषताओं की तुलना करने के लिए किया जाएगा। शोध का आयोजन कौन कर रहा है? यह शोध अध्ययन शैक्षणिक संस्थान (BBDCODS) द्वारा आयोजित किया जाता है। क्या अध्ययन के परिणाम अध्ययन समाप्त होने के बाद उपलब्ध कराए जाएंगे? हां अध्ययन की समीक्षा किसने की है? अध्ययन की समीक्षा विभागाध्यक्ष और संस्थान के IEC/IRC द्वारा की गई है और इसे अनुमोदित किया गया है। अधिक जानकारी के लिए संपर्क करें डॉ. आलिया रहमान ऑर्थोडोंटिक्स और डेंटोफेशियल ऑर्थोपेडिक्स विभाग बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज। लखनऊ-227105 मोबाइल- 9971450902

### **डॉ. वैशाली कुशवाहा**

ऑर्थोडोन्टिक्स एवं डेंटोफेशियल ऑर्थोपेडिक्स विभाग बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105 मोबाइल- 6394780893

### **डॉ. शांतनु खत्री (विभागाध्यक्ष)**

ऑर्थोडोन्टिक्स एवं डेंटोफेशियल ऑर्थोपेडिक्स विभाग बाबू बनारसी कॉलेज ऑफ डेंटल साइंसेज।

लखनऊ-227105 मोबाइल-9936424084

पीआई के हस्ताक्षर.....  
नाम.....  
तारीख.....

APPENDIX-5: GROUP I (CLASS 1 MALOCCLUSION) SUBJECT

| Overall Class I (Male - Female) |              |     |     |        |     |        |             |                   |           |           |            |         |              |              |                         |                |            |                |            |                      |                      |                  |                  |         |
|---------------------------------|--------------|-----|-----|--------|-----|--------|-------------|-------------------|-----------|-----------|------------|---------|--------------|--------------|-------------------------|----------------|------------|----------------|------------|----------------------|----------------------|------------------|------------------|---------|
| Sl No.                          | Patient Name | Age | Sex | Height | ANB | ABITOP | Max. Length | Mandibular Length | N-Perp. A | N-Perp. B | Cus-Peak A | Cus-Cus | SNA (degree) | SNB (degree) | Max. Mandib. Difference | U1-NA (degree) | U1-NA (mm) | L1-NB (degree) | L1-NB (mm) | Upper lip Protrusion | Lower lip Protrusion | Nasolabial Angle | Facial Convexity | Z angle |
| Class I (Male)                  |              |     |     |        |     |        |             |                   |           |           |            |         |              |              |                         |                |            |                |            |                      |                      |                  |                  |         |
| 1                               | ADIL         | 17  | M   | 164    | 2.9 | 2.2    | 41.2        | 31.7              | -0.2      | -3.4      | 64.7       | 70.5    | 79.3         | 76.4         | 14.8                    | 37.5           | 7.2        | 28.5           | 4.2        | 7                    | 4                    | 93.1             | 24.3             | 63.5    |
| 2                               | MOJIBTEH     | 19  | M   | 47     | 3.3 | 4      | 44.5        | 58.5              | -0.9      | -7.8      | 69.4       | 94.7    | 71.6         | 70.1         | 25.3                    | 24.8           | 6.1        | 33.8           | 7.3        | 4.3                  | -6                   | 110              | 28.3             | 56.5    |
| 3                               | MOJIB        | 16  | M   | 41     | 3.1 | 1.9    | 45.6        | 61.3              | 4.3       | 3.3       | 79.2       | 100     | 82.7         | 79.6         | 20.8                    | 20.1           | 2.6        | 43.1           | 5.7        | 5.3                  | -4.8                 | 100              | 18.7             | 67.4    |
| 4                               | PRATYISHI    | 14  | M   | 118    | 3.2 | 2.4    | 54.5        | 69.2              | 11.1      | -3.2      | 65.5       | 106     | 81           | 77.7         | 20.7                    | 33.2           | 9.9        | 32.7           | 8.3        | 1.6                  | -3.7                 | 95.1             | 20.5             | 62.3    |
| 5                               | RAHIL        | 13  | M   | 35     | 2   | 1.1    | 46.8        | 63.2              | -2.7      | -3.6      | 80.2       | 101     | 78.9         | 76.8         | 20.5                    | 23.9           | 7.7        | 33             | 7          | 5.9                  | -6.4                 | 100              | 20.5             | 67      |
| 6                               | SHANKAR      | 18  | M   | 28.5   | 1.3 | 5.6    | 59.1        | 77.4              | 2.3       | 2.2       | 80.7       | 102.6   | 83.6         | 82.1         | 21.9                    | 32.4           | 6.3        | 27.2           | 4          | 6.7                  | 0.2                  | 98.3             | 11.3             | 71.5    |
| 7                               | SADAN        | 19  | M   | 106    | 3.1 | 2.9    | 59.1        | 64.8              | -0.4      | -4.5      | 76.5       | 95.5    | 80           | 77           | 19                      | 21.2           | 7.1        | 24.8           | 7.6        | 3.6                  | -2.4                 | 117.3            | 18.8             | 61      |
| 8                               | BITHUAN      | 16  | M   | 29.5   | 4   | 1.3    | 54.1        | 75                | 0.2       | -6.8      | 67.2       | 93.8    | 78           | 74           | 26                      | 20.5           | 4.8        | 27.5           | 7.1        | 3.4                  | -2.8                 | 108.4            | 18.7             | 71.4    |
| 9                               | RAMVINY      | 18  | M   | 27.7   | 4   | 3.3    | 39          | 29.6              | 2.9       | -3.9      | 77.2       | 98.2    | 86.3         | 82.3         | 19                      | 22             | 10.5       | 39.5           | 9.3        | 6.3                  | -10.5                | 115.4            | 31.6             | 37.1    |
| 10                              | ADARSH       | 20  | M   | 29.6   | 3.5 | 8.8    | 45.1        | 65.1              | 3.6       | 1.1       | 81.5       | 110.1   | 85.8         | 82.3         | 28.8                    | 28             | 5          | 31.1           | 6.2        | 3.3                  | -3.3                 | 103.8            | 14.7             | 71.1    |
| 11                              | ANIKIMAR     | 15  | M   | 28.7   | 1.9 | 8.8    | 49.7        | 78.9              | -3.5      | -8.5      | 87.2       | 113.7   | 87.8         | 86.9         | 26.5                    | 37.2           | 11.2       | 40             | 9.1        | 5.8                  | -4.5                 | 100.5            | 14               | 75.3    |
| 12                              | ABHIRAM      | 16  | M   | 30     | 1.2 | 9.4    | 40.5        | 54.6              | 0.6       | -0.4      | 62.8       | 85.2    | 83.9         | 84.8         | 22.3                    | 21.5           | 3.2        | 14.7           | 0.8        | 6.9                  | -6.1                 | 99.3             | 10.8             | 76.9    |
| 13                              | AADITYA      | 18  | M   | 36.1   | 3.4 | 8.4    | 59.4        | 78                | 3.3       | 0.3       | 93.3       | 118.2   | 83.8         | 80.4         | 24.9                    | 25.9           | 8          | 28.3           | 6.7        | 5.1                  | -3.7                 | 104.2            | 18.8             | 72.2    |
| 14                              | ALOK         | 17  | M   | 22.1   | 3   | 4.7    | 52.9        | 80.6              | 7.9       | 7.8       | 95         | 117     | 84.1         | 81.1         | 22                      | 26.1           | 4.5        | 26.1           | 4.7        | 1.8                  | -4                   | 119.1            | 22.9             | 73.5    |
| 15                              | ARVIND       | 19  | M   | 27.2   | 1.1 | 18.4   | 77          | 117.1             | 5.6       | 7.3       | 122.9      | 152.3   | 87.8         | 86.7         | 29.4                    | 29.4           | 8.6        | 18.1           | 4.1        | 7.3                  | 2.5                  | 98.8             | 8.3              | 80.2    |
| Class I (Female)                |              |     |     |        |     |        |             |                   |           |           |            |         |              |              |                         |                |            |                |            |                      |                      |                  |                  |         |
| 1                               | SRUTHI       | 20  | F   | 26.3   | 1.4 | 6.5    | 39.1        | 30.8              | 1.6       | 0.7       | 38.7       | 125.1   | 83.9         | 82.5         | 26.4                    | 32.6           | 5.6        | 25.3           | 4          | 5.9                  | -4                   | 97.2             | 15               | 76.6    |
| 2                               | ARUNA        | 21  | F   | 35.3   | 3.6 | 1      | 44          | 37.8              | -2.3      | -9.2      | 68.9       | 88.7    | 73.4         | 71.8         | 19.8                    | 41.9           | 14.7       | 23.6           | 9.6        | 9.3                  | -8.3                 | 99.3             | 14.8             | 59.1    |
| 3                               | ANJALI       | 15  | F   | 34.8   | 3.4 | 2.5    | 43.6        | 60.6              | 1.4       | 3.4       | 72.8       | 93.2    | 76.8         | 73.4         | 20.4                    | 21.6           | 5.9        | 18.8           | 2.8        | 5.6                  | -4.6                 | 86.3             | 11               | 69.8    |
| 4                               | KAVITA       | 17  | F   | 11.6   | 3.6 | 2.9    | 52.9        | 69                | 1.8       | -2.2      | 86.3       | 107     | 78           | 74           | 21.3                    | 35.1           | 12.3       | 41.8           | 12.8       | 8                    | -11                  | 111.3            | 16               | 62.5    |
| 5                               | PURDAB       | 16  | F   | 12.8   | 2.8 | 3.2    | 51.8        | 60.1              | 1.4       | -6.4      | 73.1       | 96.1    | 80.1         | 77.3         | 23                      | 31.2           | 9.9        | 41.9           | 10.2       | 6.9                  | -6.2                 | 101.8            | 12               | 64.3    |
| 6                               | PRAYANKA     | 18  | F   | 13.7   | 3.3 | 0.3    | 50.4        | 58.9              | 2.9       | -3.9      | 74         | 95.2    | 80.7         | 77.2         | 21.3                    | 38.7           | 16         | 45.3           | 12.5       | 5.2                  | -7.2                 | 118              | 21.5             | 61.5    |
| 7                               | RASHMI       | 19  | F   | 25.4   | 2   | 10     | 43.7        | 64                | 7         | 2.1       | 79.3       | 99.1    | 84           | 81.9         | 18.6                    | 41.6           | 12.7       | 42             | 11.9       | 8.3                  | -5.1                 | 101              | 19.6             | 65.8    |
| 8                               | AMRITA       | 16  | F   | 35.6   | 2.8 | 2      | 46.6        | 64.2              | 4.6       | -1.5      | 37.5       | 93.1    | 81.9         | 80.1         | 15.6                    | 36.5           | 9.8        | 52.7           | 13.2       | 6.5                  | -10.5                | 97.5             | 20.3             | 39.3    |
| 9                               | ASHRMA       | 17  | F   | 30.9   | 3.3 | 2      | 43.3        | 65.9              | 4.3       | -1        | 84.4       | 100     | 81.8         | 79.5         | 16                      | 33.7           | 6.1        | 40.4           | 12.1       | 7.8                  | -9.8                 | 102.5            | 21               | 73.5    |
| 10                              | JITI         | 15  | F   | 29.3   | 2.9 | 4.1    | 47.5        | 67.8              | -3.3      | -3.1      | 84.4       | 113     | 82.8         | 80.8         | 28.4                    | 38.3           | 1.9        | 49.9           | 14         | 7.5                  | -12.9                | 114.3            | 20.5             | 59.8    |
| 11                              | KASHISHI     | 16  | F   | 36.3   | 2.9 | 5.6    | 39.1        | 67.7              | 1         | -0.2      | 72.8       | 93.4    | 80.5         | 78           | 20.6                    | 24.3           | 4          | 27             | 4          | 5.6                  | -3.9                 | 103.4            | 13.8             | 67      |
| 12                              | UNAZA        | 18  | F   | 25.4   | 3.6 | 6.4    | 50          | 67.5              | 7.2       | 7.2       | 81         | 104.4   | 84.7         | 81.1         | 10.4                    | 30.3           | 6.1        | 29.4           | 5.7        | 2.4                  | -0.4                 | 92               | 10.9             | 82.1    |
| 13                              | MINIKAN      | 12  | F   | 11.6   | 1.8 | 1.9    | 30.8        | 71.3              | -3.4      | -3.5      | 70.9       | 78.4    | 82           | 78.5         | 13.5                    | 44.3           | 9.7        | 33.8           | 5.3        | 4.6                  | -2.3                 | 99.4             | 14.1             | 39.1    |
| 14                              | SHIVA        | 15  | F   | 28.6   | 1.2 | 9.9    | 37.6        | 56.1              | -0.3      | -2        | 67.9       | 91.9    | 80.5         | 78.7         | 24                      | 30.8           | 8.8        | 21.2           | 4.6        | 4.6                  | -4.5                 | 101.7            | 11.2             | 80.1    |
| 15                              | PRATINA      | 17  | F   | 27.1   | 3.6 | 2.6    | 37.8        | 52.3              | 6.2       | 4.5       | 64.7       | 79.1    | 81.5         | 75.9         | 17.4                    | 29.7           | 5.9        | 33.3           | 6.6        | 5                    | -3.8                 | 92.8             | 19.7             | 72.1    |

## APPENDIX-6: GROUP II (CLASS DIVISION 1 MALOCCLUSION)

### SUBJECTS

| St No. | Patient Name | Age  | Sex | Hand Preference | ANB  | ABT OF | Max Length | Maxillary Length | N-Prpjm. A | N-Prpjm. B | C-P Angle A | C-P Angle B | SNA   | SNB  | Max. Mand. Difference | U1-N1 (Degree) | U1-S1 (mm) | L1-S1 (mm) | L1-N1 (Degree) | L1-S1 (mm) | Upper Lip Protrusion | Lower Lip Protrusion | Overbite Angle | Facial Convexity | Z angle |      |      |
|--------|--------------|------|-----|-----------------|------|--------|------------|------------------|------------|------------|-------------|-------------|-------|------|-----------------------|----------------|------------|------------|----------------|------------|----------------------|----------------------|----------------|------------------|---------|------|------|
| 1      | Corbin       | 17-M |     |                 | 32.7 | 6.8    | 5.2        | 42.5             | 63.8       | 1.1        | -2          | 76.1        | 32.9  | 83.1 | 76.3                  | 74.5           | 13.8       | 24.5       | 4.1            | 26.4       | 3.3                  | 3.4                  | -4.9           | 120.5            | 15.1    | 72.5 | 74.1 |
| 2      | Levin        | 15-M |     |                 | 38.9 | 5.9    | 1.2        | 47.1             | 61.5       | 0.1        | -8.9        | 82.8        | 109.7 | 79.6 | 74.5                  | 26.8           | 34.1       | 8.4        | 17.9           | 4.7        | 9.5                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 3      | Malocclusion | 16-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 4      | Levin        | 16-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 5      | Levin        | 17-M |     |                 | 26.2 | 4.9    | 3.5        | 37               | 54.6       | 3.7        | 1.3         | 65          | 79    | 85.6 | 80.6                  | 15             | 34.1       | 4.7        | 26.9           | 5.4        | 5.2                  | -4.6                 | -4.6           | 89.7             | 15.9    | 70.6 | 68.8 |
| 6      | Levin        | 18-M |     |                 | 39.5 | 6.8    | 0.6        | 48.4             | 65         | 0.8        | -2.5        | 82.2        | 105.7 | 80.4 | 74.5                  | 20.5           | 34.1       | 10.4       | 17.9           | 8.2        | 8.2                  | -4.6                 | -4.6           | 82.6             | 17.9    | 70.6 | 70.1 |
| 7      | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 8      | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 9      | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 10     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 11     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 12     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 13     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 14     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 15     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 16     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 17     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 18     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 19     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 20     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 21     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 22     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 23     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 24     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 25     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 26     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 27     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 28     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 29     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 30     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 31     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 32     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 33     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 34     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 35     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 36     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 37     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 38     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 39     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 40     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 41     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 42     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 43     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 44     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 45     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 46     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 47     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 48     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 49     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 50     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.9             | 22.5    | 60.1 | 55.7 |
| 51     | Levin        | 17-M |     |                 | 36.9 | 5.1    | 10.5       | 47.5             | 62.5       | -0.6       | -2.7        | 82.9        | 111.1 | 83.5 | 74.5                  | 31.5           | 31.1       | 12.5       | 17.9           | 8.2        | 8.2                  | -2.5                 | -2.5           | 97.              |         |      |      |

# APPENDIX-7: GROUP III (CLASS II DIVISION 1 SUBDIVISION MALOCCLUSION) SUBJECTS

| SI No. | Patient Name | Age | Sex | Mand. Plane | ANB  | AB II OP | Max. Length | Mandibular Length | N Perpen. A | P Perpen. B | Class II Division 1 Subdivision | Co-Cen (Degrees) | SNA  | SNB  | Max. - Mand. (Degrees) | U1-NA | U1-NA (mm) | L1-NB | L1-NB (mm) | Upper lip Protrusion | Lower lip Protrusion | Neonathal Convexity (U1-P) | Facial Convexity (U1-P) | Z-angle (U1-L1-P) |      |
|--------|--------------|-----|-----|-------------|------|----------|-------------|-------------------|-------------|-------------|---------------------------------|------------------|------|------|------------------------|-------|------------|-------|------------|----------------------|----------------------|----------------------------|-------------------------|-------------------|------|
| 1      | Ashbach      | 15M |     | 27.6        | 5    | 2.1      | 55.1        | 71.5              | 7.1         | -1.1        | 80.2                            | 104.9            | 85.7 | 78.2 | 18.3                   | 37.4  | 7.4        | 30.9  | 6.6        | 9.7                  | -8                   | 103.7                      | 35.1                    | 61.8              | 49.2 |
| 2      | Munoz        | 14M |     | 28.2        | 7    | 5.3      | 53.4        | 67                | 0.37        | -10.1       | 82.2                            | 98.2             | 80.8 | 76.3 | 15.9                   | 21.7  | 3.9        | 25.5  | 4.2        | 6.6                  | -8.1                 | 106.5                      | 25.4                    | 59.6              | 30.4 |
| 3      | Arpat        | 11M |     | 30.6        | 4.5  | 2.1      | 59.2        | 63.6              | 0.5         | -46         | 92                              | 118.7            | 86.8 | 82.6 | 25.7                   | 31.9  | 10.3       | 33    | 9.8        | 9.1                  | -8.8                 | 92.9                       | 18.2                    | 70.7              | 37.4 |
| 4      | Geetham      | 16M |     | 28.1        | 4.2  | 8        | 58          | 83.6              | 0.3         | -3.1        | 86.5                            | 111.5            | 79.5 | 74.6 | 25                     | 24.5  | 6.3        | 29.8  | 7.1        | 8.1                  | -9.8                 | 96                         | 17                      | 61.4              | 56   |
| 5      | Latha        | 17M |     | 42.7        | 4.9  | 2.4      | 54.6        | 77.3              | 3.8         | -2.5        | 80.9                            | 109              | 80.4 | 80.4 | 23.1                   | 22.6  | 6.6        | 31.2  | 8.7        | 8.6                  | -8                   | 96                         | 17.9                    | 59.9              | 35.6 |
| 6      | Sita         | 18M |     | 26.5        | 5.6  | 3.1      | 51.5        | 66.1              | 4.4         | -1          | 80.9                            | 92.7             | 79.1 | 73.6 | 21.6                   | 26.4  | 9.4        | 34.8  | 8.8        | 5.9                  | -7.4                 | 104.7                      | 28.4                    | 56.7              | 49   |
| 7      | Ram          | 17M |     | 27.7        | 5.2  | 2.9      | 51          | 58.7              | -2.2        | -10.8       | 95.1                            | 113.6            | 82.1 | 77.5 | 28.5                   | 38.5  | 9.5        | 28.6  | 6.1        | 5.3                  | -2.1                 | 104.7                      | 17.7                    | 72.7              | 73.1 |
| 8      | Shyam        | 16M |     | 31.7        | 4.8  | 2.2      | 58          | 75.3              | 1.9         | -4.3        | 95.1                            | 113.6            | 82.1 | 77.5 | 28.5                   | 38.5  | 9.5        | 28.6  | 6.1        | 5.3                  | -2.1                 | 104.7                      | 17.7                    | 72.7              | 73.1 |
| 9      | Mishchak II  | 15M |     | 36.2        | 10.4 | -2.3     | 46.5        | 62                | 5.7         | -7.7        | 84.8                            | 100.7            | 77.5 | 71.6 | 25.7                   | 38.5  | 9.5        | 28.6  | 6.1        | 5.3                  | -2.1                 | 104.7                      | 17.7                    | 72.7              | 73.1 |
| 10     | Prashanth    | 15M |     | 32.4        | 4    | 2.9      | 43.2        | 33.9              | 0.4         | -46         | 87.3                            | 76.7             | 71.8 | 71.8 | 19.8                   | 14.1  | 7.7        | 23.8  | 6.9        | 6.3                  | -8.3                 | 103.8                      | 18.8                    | 61.5              | 33.5 |
| 11     | Rishabh      | 19M |     | 32.4        | 5    | 2.9      | 43.2        | 33.9              | 0.4         | -46         | 87.3                            | 76.7             | 71.8 | 71.8 | 19.8                   | 14.1  | 7.7        | 23.8  | 6.9        | 6.3                  | -8.3                 | 103.8                      | 18.8                    | 61.5              | 33.5 |
| 12     | Shikham      | 20M |     | 21.5        | 6.4  | 4        | 43.6        | 53.9              | 6.8         | -3.2        | 71.3                            | 86.3             | 88.7 | 82.3 | 16                     | 17    | 1.9        | 21.4  | 3.1        | 7                    | -6.2                 | 90.8                       | 26.5                    | 61.1              | 48.8 |
| 13     | Surkani      | 16M |     | 25.1        | 4.9  | 3.4      | 50.1        | 67.3              | -4.3        | -15.9       | 81.7                            | 104.1            | 80.5 | 79.5 | 22.4                   | 34.7  | 8          | 29.3  | 4.3        | 5.7                  | -3.9                 | 117.6                      | 27                      | 62.1              | 68.6 |
| 14     | Vincent      | 18M |     | 23.5        | 4.6  | 3.7      | 42.4        | 68.9              | -2.9        | -8.6        | 79.2                            | 99.1             | 80.2 | 75.5 | 19.9                   | 41.9  | 11.2       | 26.8  | 5          | 3.3                  | -1                   | 104.9                      | 21.6                    | 69                | 72.7 |
| 15     | Mam          | 19M |     | 25.1        | 4.1  | 4.1      | 45.8        | 60.7              | -2.6        | -0.2        | 77.5                            | 96.9             | 82.8 | 78.7 | 22                     | 25.4  | 5.9        | 26.6  | 4.9        | 5                    | -3.8                 | 109.7                      | 20.5                    | 68.4              | 67.5 |
| 1      | Aditi raj    | 15F |     | 24.1        | 4.6  | 3.1      | 49.9        | 66                | 4.7         | -2.2        | 83.7                            | 101.5            | 84.2 | 79.2 | 17.8                   | 39.7  | 8.4        | 21.1  | 4.7        | 5.5                  | -4.9                 | 101.4                      | 16.1                    | 68.6              | 62.7 |
| 2      | Koushik      | 17F |     | 25.2        | 4.8  | 3.2      | 62.7        | 64.5              | 2.6         | -2.1        | 82.3                            | 89.3             | 79.6 | 76.5 | 16.5                   | 22.3  | 3.7        | 31.8  | 5.7        | 3.8                  | -4.5                 | 105.2                      | 10.5                    | 70.2              | 67.9 |
| 3      | Koushik      | 12F |     | 25.2        | 4.8  | 3.2      | 62.7        | 64.5              | 2.6         | -2.1        | 82.3                            | 89.3             | 79.6 | 76.5 | 16.5                   | 22.3  | 3.7        | 31.8  | 5.7        | 3.8                  | -4.5                 | 105.2                      | 10.5                    | 70.2              | 67.9 |
| 4      | Mam          | 21F |     | 20.2        | 5.2  | 3.2      | 58.6        | 71.9              | 4.3         | -2.5        | 87.2                            | 102.6            | 83.2 | 78   | 15.4                   | 25.7  | 11.1       | 44.1  | 11.2       | 8.3                  | -6.7                 | 103.4                      | 18.8                    | 61.8              | 31   |
| 5      | Rajani       | 20F |     | 28.7        | 4.9  | 3.2      | 55.4        | 74.9              | 4.8         | -10.2       | 93.8                            | 117.6            | 83.3 | 78.2 | 23.8                   | 30.1  | 6.2        | 23.2  | 5          | 3.3                  | -1.9                 | 106.2                      | 21.7                    | 82.5              | 82.8 |
| 6      | Rishabh      | 21F |     | 38          | 6    | 2.8      | 52.1        | 62.2              | 2.7         | -5.7        | 80                              | 105.8            | 79.9 | 74   | 25.8                   | 23.3  | 7.5        | 28.2  | 8.5        | 7.9                  | -8.7                 | 104.1                      | 29.7                    | 57.1              | 41.3 |
| 7      | Suresh       | 24F |     | 34.6        | 7.9  | 2.2      | 32.3        | 47.5              | 3.5         | -2.2        | 64.5                            | 78.7             | 89.9 | 81.9 | 14.1                   | 22.6  | 1.5        | 30.7  | 5.3        | 4.6                  | -3.8                 | 109                        | 14.8                    | 70                | 62.5 |
| 8      | Yashodhary   | 20F |     | 41          | 4.6  | 8.5      | 33.5        | 59.5              | -0.4        | -4.5        | 72.6                            | 100.5            | 74.6 | 72.3 | 27.9                   | 39.4  | 11.3       | 25.4  | 4.9        | 6.6                  | -5.4                 | 86                         | 11                      | 71.5              | 67.6 |
| 9      | Prashanth    | 16F |     | 22.4        | 5.3  | 8.5      | 42.7        | 52.4              | 3.8         | -3.4        | 71.7                            | 89.4             | 91.9 | 89.3 | 17.9                   | 27.7  | 4.7        | 26.2  | 5.2        | 4.7                  | -2.6                 | 97.9                       | 12.7                    | 77                | 77.6 |
| 10     | Mishchak     | 18F |     | 32.2        | 4.8  | -0.5     | 39.9        | 52.4              | 11.7        | 8           | 67.1                            | 85.6             | 88.7 | 74.6 | 14.6                   | 19.5  | 2          | 34.6  | 6.7        | 5.9                  | -6.3                 | 94.4                       | 19.5                    | 66.1              | 55.1 |
| 11     | Prashanth    | 17F |     | 32.2        | 4.8  | -0.5     | 39.9        | 52.4              | 11.7        | 8           | 67.1                            | 85.6             | 88.7 | 74.6 | 14.6                   | 19.5  | 2          | 34.6  | 6.7        | 5.9                  | -6.3                 | 94.4                       | 19.5                    | 66.1              | 55.1 |
| 12     | Vandana      | 20F |     | 31          | 7.8  | -2.9     | 33.1        | 36.8              | 2.3         | -1.6        | 79.4                            | 91.9             | 83.1 | 75.5 | 12.5                   | 27.9  | 6.3        | 34.1  | 11.6       | 8.8                  | -1.1                 | 89.4                       | 21.6                    | 54.6              | 46.9 |
| 13     | Mam          | 19F |     | 25.1        | 9.6  | -2.8     | 36.1        | 52.5              | 4.8         | -2.2        | 88.5                            | 105.8            | 80.8 | 75.2 | 8.9                    | 28.1  | 2.4        | 22.4  | 3.2        | 2.3                  | 0                    | 114.7                      | 20.8                    | 71.4              | 75.6 |
| 14     | Mam          | 22F |     | 27.5        | 5.6  | 2.5      | 36.4        | 65.8              | 3.1         | -2.1        | 88.5                            | 105.8            | 80.8 | 75.2 | 8.9                    | 28.1  | 2.4        | 22.4  | 3.2        | 2.3                  | 0                    | 114.7                      | 20.8                    | 71.4              | 75.6 |
| 15     | Zarith       | 19F |     | 39.6        | 4.5  | -0.8     | 44          | 55.4              | 3.2         | -0.5        | 68                              | 83.6             | 74.7 | 70.3 | 15.6                   | 39.6  | 10.8       | 27.5  | 5.7        | 5.3                  | -3.4                 | 81.6                       | 20.6                    | 68.4              | 68.3 |

## APPENDIX-8: FORMULATION USED FOR STATISTICAL ANALYSIS

Data was entered into Microsoft Excel spreadsheet and was checked for any discrepancies. Summarized data was presented using Tables and Graphs. The data was analysed by SPSS (21.0 version). Shapiro Wilk test was used to check which all variables were following normal distribution. Data was normally distributed therefore; inferential statistics were performed using the parametric test. For comparison of continuous quantitative data among more than two groups, ONE WAY ANOVA followed by Tukeys test were used. For intergroup comparison of independent data, independent t test was used. For finding association among categorical variable chi square test was used. Level of statistical significance was set at p-value less than 0.05 (\*).

Formula used for the analysis

The Arithmetic Mean

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

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

A. The Standard Deviation

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

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

where, n= no. of observations

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

B. 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. 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 hypothesis( $H_0$ ) & alternate hypothesis( $H_1$ )

Find  $t$  value, Find ( $X_1 - X_2$ )

Calculate SE of difference between two means

$SE = \sigma \sqrt{1/n_1 + 1/n_2}$  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 theoretical  $t$  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  $\alpha$  applies to all rows of the  $j^{\text{th}}$  column i.e. the value  $\alpha_{ij}$  is the same for all i).
- $\varepsilon_{ij}$  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.

### III. CHI-SQUARED TEST

- It is to determine if there is any association between categorical data from two or more groups.
- Categorical data are data that can be separated into distinct groups that do not have a numerical relationship or order between them.

Methodology.

(a) Make a contingency table. Data are organized into a contingency table comprising row, and columns. The categories for one variable define the rows, and the categories for the other variable defines column.

(b) Test the difference between observed and expected values.

1. Test compares the size of the discrepancy between the numbers observed in the rows and columns against the number that would be expected if the null hypothesis (that there are no differences between the groups) was true.
2. If the observed and expected values are close then it would be reasonable to anticipate that the null hypothesis is true. 2
3. Chi square distribution is a family of probability density curves that are defined by the number of degrees of freedom.
4. The test statistic CHI square is a squared value it will, always be positive and greater than zero irrespective of the direction of the difference between samples (i.e. greater than or less than).

5. Right hand tail of the CHI square distribution therefore represents the two-tailed probability that the samples were derived from the same population. 2 CHI square tests are therefore always regarded as two sided.

Assumptions.

1. Sample is randomly selected from the population.
2. Actual frequencies (not percentages or proportions) are entered into the contingency table.
3. Observations should be independent (not paired) if data are paired, McNemar's test should be used.
4. All values must be greater than 1. 5. 80% of the expected values must be >5.

$$\chi^2_c = \sum \frac{(O_i - E_i)^2}{E_i}$$

O : OBSERVED FREQUENCY

Statistical significance

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

|          |                      |
|----------|----------------------|
| p > 0.05 | Not significant (ns) |
| p < 0.05 | significant (*)      |

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