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Evaluation of Upper Incisor Position and Its Comparison with Lip Posture in Orthodontically Treated Patients.

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Abstract:*Introduction: Harmony And Balance Between The Facial Features Is An Integral Part Of Orthodontist's Responsibility. Incisor Position Plays An Important Role In Determining Lip Posture*
Aim And Objectives: The Aim Of The Study Is To Evaluate The Incisor Position Using Hard Tissue Nasion-Pogonion(N-Pog) Line, A-Line (By Alvarez A.) And Soft Tissue Parameters I.E. Forehead Facial Plane (FFP) And Forehead Midpoint Plane (FMP) And To Compare It With Lip Posture Assessed Using S-Line And B-Line On Lateral Cephalogram.MaterialsAnd Methods: Sample Comprised Of 30 Post Treatment Lateral Cephalograms Of Patients With Class I Molar Relation And Normal Overjet And Overbite. Cephalograms Were Traced Manually And Both Soft And Hard Tissue Landmarks Were Located. Upper Incisor Position Was Evaluated Using N-Pog, A-Line, FFP And FMP. Lip Posture Was Assessed Using Steiner's S-Line AndBurstone's B-Line. Measurements Obtained Were Subjected To Statistical Analysis.
Statistical Analysis: Correlation Between The Lip Posture And Each Upper Incisor Determining Parameter Was Done Using A Linear Regression Correlation Test.Results: The Position Of Upper Incisor Using N-PogTo Lower Lip Posture Showed Extreme Significance. Moderate Significance Was Obtained Between N-PogTo Upper Lip AndFFP To Lower Lip. Rest Of The Parameters Were Not Significant. The Mean Value Of A-Line To Incisor Position Was 1.18mm.Conclusion:

1. *N-PogLine Can Be Used As A Reliable Parameter To Determine Upper Incisor Position And Lip Posture And FFP Can Be Used For Lower Lip Posture.*
2. *Mean Value Of Upper Incisor ToA-Line Was 1.18mm.*

Keywords:*Lateral Cephalogram, UpperIncisor Position, Lip Posture, A- Line.*

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I. Introduction

Harmony And Balance Between The Facial Features Is An Important Part Of Orthodontist's Responsibility. The Facial Soft-Tissue Plays A Significant Role In The Esthetics, Speech And Other Physiologic Functions. The Success Of Orthodontic Treatment Is Closely Related To The Changes In Soft Tissue Profile Of The Patient Also Not Merely Correction Of Malocclusion. Lip Posture Is One Of The Main Esthetic Outcome Expected By The Patients From Orthodontic Therapy. Therefore To Obtain A Good Facial Balance, Both Hard Tissue And Soft Tissue Have To Be Taken Into Consideration.

In Recent Times Treatment Mechanics Gives Importance To The Upper Incisor Position And Rest Of The Teeth Are Aligned According To That.[1]The Profile Of The Patient Is Judged Many A Times By The Position Of The Anterior Teeth. In Contemporary Orthodontics Upper Incisors Have Been Assessed From The Frontal View Which Included The Amount Of Display. However From The Profile View, Incisors Can Be Assessed With Respect To The Soft Tissues. With Improvement Of Orthodontic Mechanotherapy, Emphasis Has Shifted More Towards Envisioning An Ideal Position Of Upper Incisors As The Starting Point In Treatment Planning. Neger[2]Introduced A Method For Evaluating The Soft-Tissue Profile In A Quantitative Manner With The Help Of Profile Photographs And Cephalograms.

Studies Have Used Point A-PogonionLine To Evaluate The Position Of Upper Incisors. Edward Ellis And McnamaraJ [3] Conducted A Study To Evaluate Upper And Lower Incisor Positions Using Various Parameters. But They Did Not Correlate The Incisor Position To Soft Tissue Changes.

It Was Andrews[4]Who Advocated Forehead To Be Used For Evaluation Of Upper Incisor Position. He Defined Certain Landmarks On The Forehead And Correlated Them To The Incisor Position In Patients With Good Profile.

Alvarez A.[5] Defined A New Line Named As A-Line To Determine The Position Of Upper Central Incisors In Untreated Class I Patients With Pleasing Profiles.

Clinicians In The Past Have Introduced Many Lines To Assess The Lip Position. A Study By Peter Buschang And Colleagues[6] Correlated All The Lines Available To Lower Lip But Did Not Get Significant

Values. Even Though Many Studies Have Compared The Change In Lip Positions With Incisor Retraction Using Different Mechanotherapy, None Of The Studies Have Given A Mathematical Correlation Of Incisor Position For Good Lip Posture.

In The Present Study We Have Evaluated Incisor Position Using Four Parameters And Correlated Them With Lip Position To Assess Which Parameter Gives Approximately Ideal Lip Posture.

Therefore, The Aim Of The Study Is To Correlate The Incisor Position And Lip Posture Using Two Hard Tissue And Two Soft Tissue Parameters On Lateral Cephalogram. Evaluation Of The Position Of Upper Incisor Using Hard Tissue; Nasion-Pogonion(N-Pog) And A-Line And Soft Tissue; Forehead Facial Plane (FFP) And Forehead Midpoint Plane (FMP) And Lip Posture Using Steiner's (S) Line And Burstone's(B) Line.

II. Material And Methods

Thirty Post Treatment Lateral Cephalograms Were Selected Regardless Of The Type Of Initial Malocclusion And The Type Of Fixed Mechanotherapy Used.

The Inclusion Criteria Was:

- All The Patients Had Class I Molar Relation And Approximately Ideal Over Jet And Overbite At End Of The Treatment.
- ANB Angle Was Between 2˚ To 4˚
- All Patients Had Harmonious And Well Balanced Facial Profile.

A 0.003 Inch Acetate Sheet Was Placed Over The X-Ray Film And Soft And Hard Tissue Landmarks And Planes Were Located Manually Using A 0.035mm Mechanical Black Pencil.
Landmarks Were As Shown In Fig. 1.

Hard Tissue Landmarks: Anterior Nasal Spine (ANS), Clinoidale(Cl), Floor OfSella (SF), Gonion(Go), Menton(Me), Nasion(N), Orbitale(Or), Pogonion(Pog), Point A (Pt A), Porion(Po), Roof Of Orbit (Ro)
Soft Tissue Landmarks: Trichion(Tr), Glabella (G), Subnasale(Sn), Soft Tissue Pogonion(Pog').
The Following Planes And Lines Were Used –

- **N-Pog**: Line Joining The Hard Tissue NasionAnd Pogonion(Fig. 2)
- **A-Line:**Parallel Line To True Horizontal Line (Or-Po) Was Drawn From Point A On Maxilla To The Upper Lip Soft Tissue. It Was Divided Into Thirds And A Line Was Drawn From The Nearest One Third To Point A Perpendicular To True Horizontal. This Line Was Marked As "A-Line". (Fig. 2)
- Horizontal Reference Plane: Anterior Cranial Base Line Was Constructed From Roof Of Orbit To Clinoidale(Ro To Cl). A Parallel Line Was Drawn To This Passing Through The Floor Of Sella (SF). Mandibular Plane Was Drawn Connecting MentonAnd Gonion(Me-Go). Both The Above Lines Were Extended Distally To Meet At A Point. A Line Was Drawn From ANS To This Point Marked As "Horizontal Reference Plane". (Fig. 3)
- **Forehead Midpoint Plane (FMP)**: A Line Connecting TrichionTo Glabella (Tr-G) Was Drawn And A Perpendicular Line Bisecting This Line Was Drawn To Soft Tissue Forehead. That Point Was Marked As Forehead Midpoint. A Perpendicular Line Was Drawn Forehead Midpoint ToHorizontal Reference Plane Marked As FMP. (Fig. 4)
- **Forehead Facial Plane (FFP):**Line Drawn From Glabella Perpendicular ToHorizontal Reference Plane. (Fig. 4)
- **Steiner's "S" Line:**Line Joining Soft Tissue Pogonion(Pog') And Midpoint Of ColumellaOf The Nose. (Fig. 5)
- **Burstone's"B" Line**: Line Joining Soft Tissue Pogonion(Pog') And Subnasale(Sn). (Fig. 5)

Linear Measurements Were Made From N-Pog, A-Line, FMP And FFP To The Most Anterior Surface Of The Maxillary Central Incisor To Evaluate The Upper Incisor Position. Lip Posture Was Evaluated By Measuring Linear Distance Between S-Line And B-Line And The Anterior Point On The Upper And Lower Lip.

Positive Number Was Assigned If The Incisor Was Anterior To The Line And Negative Number Was Assigned If The Incisor Was Behind The Line. The Measurements Were Repeated After 1 Week And Method Error Was Calculated Using Dahlberg Formula. [7]

III. Statistical Analysis

Correlation Between The Lip Posture And Each Upper Incisor Determining Parameter Was Done Using A Linear Regression Correlation Test At 95% Interval. P Value Was <0.05. Each Parameter Was Correlated With Both Upper Lip And Lower Lip Values. (Table 1).

IV. Results

The Mean Values Of Linear Measurements From Upper Incisor To N-Pog, A-Line, FFP And FMP Were 9.21, 1.18, 9.35 And 15.8 Respectively. The Standard Deviation Was 2.791, 2.061, 4.02, And 6.02. The Standard Deviation Was More In Upper Incisor To FMP Was Probably Because The TrichionPoint Was Approximately Marked On The Cephalogram. The Mean Values OfS-Line To Upper Lip And Lower Lip And B-Line To Upper Lip And Lower Lip Were 1.2, 4.78, 4.78 And 5.1 Respectively. The Standard Deviations Were 1.85, 1.93, 1.93 And 2.24.

Significant Correlation (*) Was Seen Between N-PogAnd Upper Lip And FFP And Lower Lip. (Fig. 6, 8) The P Value OfN-PogTo Lower Lip Was 0.0001 (***) Suggesting Extreme Significance. (Fig. 7). The Other Parameters Did Not Show Any Significance To The Lip Posture.

V. Discussion

This Is A Retrospective Study To Evaluate Upper Incisor Position And Its Comparison With Lip Posture. The Sample Included Adult Subjects Therefore The Growth Was Completed In All Patients.

Arnett Et Al[8] Developed A Soft Tissue Cephalometric Analysis Tool Where They Had Given Importance To Hard Tissue As They Believed That Hard Tissues Control The Esthetic Outcome Of The Treatment To A Large Extent. They Evaluated The Planned Incisor Position For Different Soft Tissue Conditions Which Included Lip Thickness And Lip Support. Studies Have Used Photographs And Silhouettes To Assess The Lip Posture And Facial Profile Of The Patient.

There Is An Increased Importance Given To Anterior Teeth; Be It To Plan The Incisor Position Or To Assess The Esthetic Profile Of The Patient. In The Present Study We Have Evaluated The Incisor Position Using Two Soft Tissue And Two Hard Tissue Parameters.

Holdaway[9,10]first Suggested Maxillary Incisors As Best Teeth For Esthetic Prognosis As They Determine Upper And Lower Lip Postures. Riedel[11]First Used N-PogAs A Reference Line To Evaluate The Incisor Position In Place Of A-PogAs Point A Is A Highly Variable Point. NasionIs Also A Variable Point But It Is More Reliable Than Point A As Maxilla Is Most Affected By Malocclusion. Edward Ellis And McnamaraJ.[3] Evaluated Upper Incisor Position Using N-Pog. They Found Significant Correlation. Therefore We Have Considered N-PogLine In This Study.

Alvarez A.[5] Was Not Convinced Regarding The Stability Of Conventionally Used Landmarks To Determine Incisor Position. He Introduced A-Line To Assess The Incisor Position In Untreated Class I Subjects And Concluded That Ideal Tooth Position Is Seen When The A-Line Touches Or Passes Within 1mm Of Facial Surface Of Maxillary Central Incisor. In The Present Study We Obtained A Mean Value Of 1.18mm. This Might Be Because Of The Difference In Samples Selected In His Study And The Present Study.

Andrews[4]Popularized The Use Of Forehead Landmark To Assess The Anteroposterior Position Of The Upper Incisors. He Defined Certain Forehead Landmarks And Found Marked Correlation Between The Forehead Inclination And Prominence And Position Of Upper Central Incisors.

Adams M. Et Al[12] Evaluated Photographs To Compare The Anteroposterior Relationship Of The Maxillary Central Incisors To Forehead In Adult White Males And Found Marked Correlation Between Forehead Inclination And Incisor Position. They Also Found That The Incisor Was Positioned Between Forehead Facial Axis And Glabella. Similar Study Was Done By Will Alan Andrews[13]In Adult White Females And Concluded Similar Results.

Recently, Michael A. Webb[14]And Colleagues Have Evaluated Upper Incisor Position As A Determinant Of Ideal Soft Tissue Profile And Concluded That The Incisors Were Positioned Between Forehead Facial Plane And Forehead Midpoint Plane.

Lip Position Has Become One Of The Most Important Soft Tissue Analyses As It Influences The Occlusion, Tooth Stability And Facial Aesthetics.[15] Orthodontic Literature Has A Vast Array Of Reference Lines To Assess The Anteroposterior Lip Position Such As Sushner's S2 Line, Steiner's S1 Line, Burrstone's B Line, Ricketts E Line And Holdway's H Line. The Norms Of These Lines Have Been Defined For Different Races. Clinicians Believe That There Is A Vast Difference In Norms Among Different Ethnic Groups. Merina Joshi And Colleagues [16] Evaluated The Reliability Of Different Reference Lines To Lower Lip But They Did Not Get Any Significant Findings.

In The Present Study, Lip Posture Was Evaluated Using S-Line And B-Line. Literature Reports Highest Correlations Between S-Line And B-Line Because Of The Close Proximity Of The Landmarks I.E. -SubnasaleAnd Columella.

Several Studies Have Been Done Comparing The Changes In Lip Position Depending On Incisor Retraction. But None Of The Study Has Reported Any Quantitative Findings Correlating Upper Incisor Position And Lip Posture. In The Present Study, We Have Tried To Evaluate Which Of The Parameters Used To Determine The Upper Incisor Position Gives Acceptable Lip Position.

The N-PogTo Lower Lip Correlation Was Highly Significant. And Upper Lip Correlation With N-PogAnd FFP Was Moderately Significant. Hence We Can Conclude That At Ideal Incisor Position The N-PogPlane Can Be Used To Evaluate Esthetic Lip Position. Also FFP Can Be Used When Lower Lip Position Needs To Be Evaluated. Both A-Line AndFMP Showed No Significance. This Might Be Because Of The Variability Of The A-Point As Suggested By Reidel. For Deriving The FMP, TrichionWas One Of The Points Considered. This Point Was Approximately Marked On The Radiograph By Visualizing Patient's Photographs. Also The Soft Tissue Thickness Varies In Different Individuals. Therefore, There Should Be A Pre Decided Range Of Soft Tissue Thickness In The Inclusion Criteria. This Study Has Also Not Taken Into Consideration The Lip Thickness And Lip Strain Which Also Influences The Lip Posture.

VI. Conclusion

Orthodontists Need Definitive Guidelines To Determine The Esthetic Position Of The Lips. Upper Incisor Position Can Be Used As A Key Element For The Same. The Present Study Gave Clinical Applicability Of N-PogAnd FFP To Determine Ideal And Esthetic Lip Posture And Incisor Position. Also The Mean A-Line Value To Determine Position Of Upper Incisor In The Inclusion Population Was 1.18mm.

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TABLES

Table 1: Correlation Between Soft And Hard Tissue Parameters And Lip Posture.

Parameter	Upper Lip		Lower Lip	
	P Value	Correlation Coefficient (R)	P Value	Correlation Coefficient (R)
N-Pog	0.0119*	0.322	0.0001***	0.497
A-Line	0.5312	-0.082	0.9412	-0.0097
FFP	0.0769	0.076	0.0353*	-0.272
FMP	0.5113	0.0864	0.1806	0.1752

(*, ***P < 0.05)

FIGURES AndLEGENDS

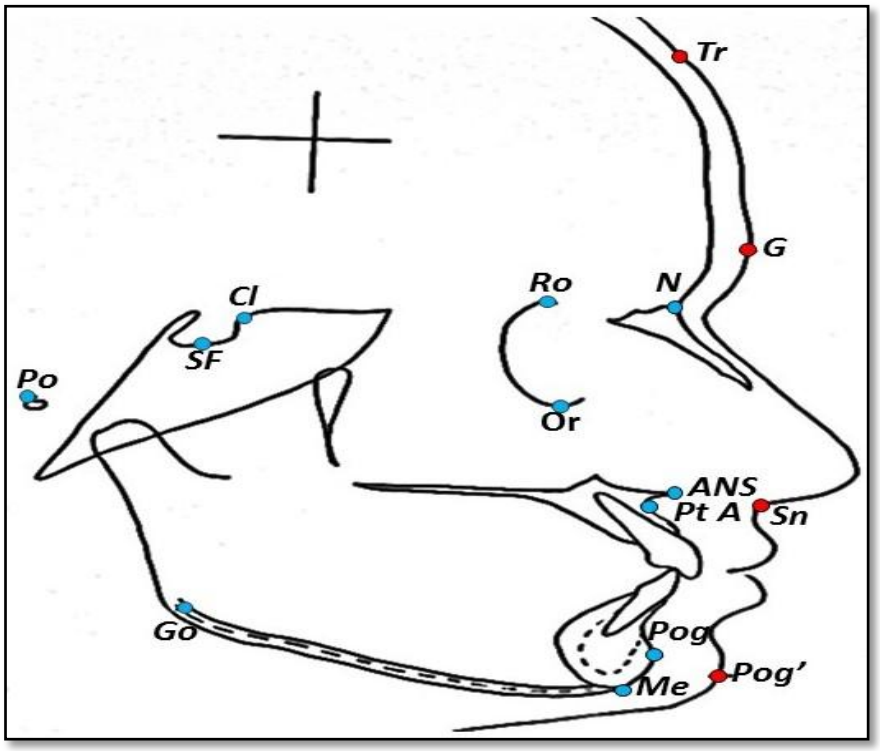

Fig. 1: Hard AndSoft Tissue Landmarks

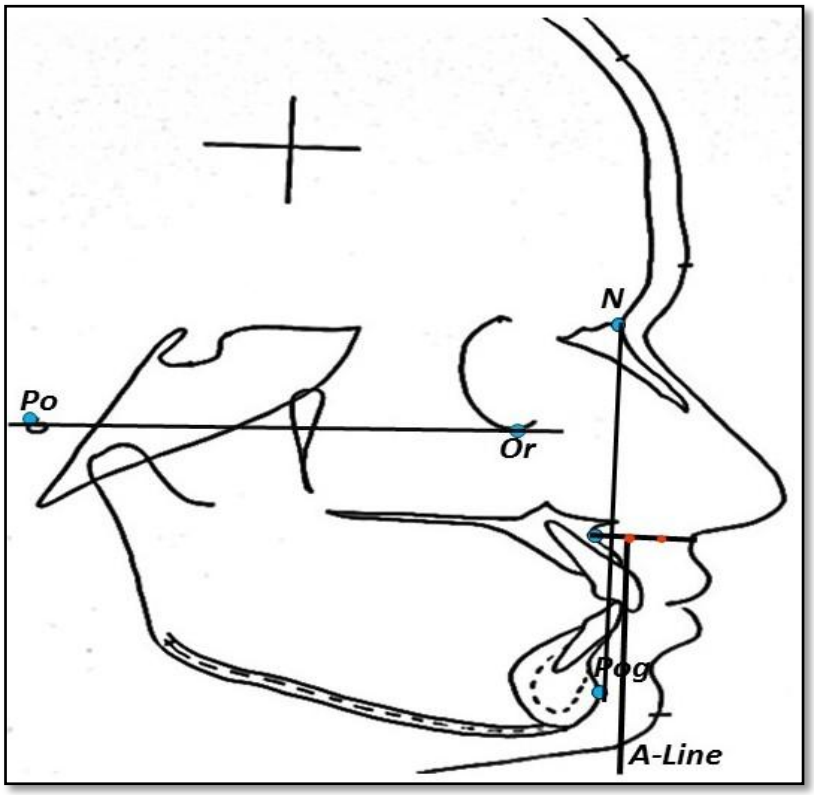

Fig. 2:N-PogAndA-Line

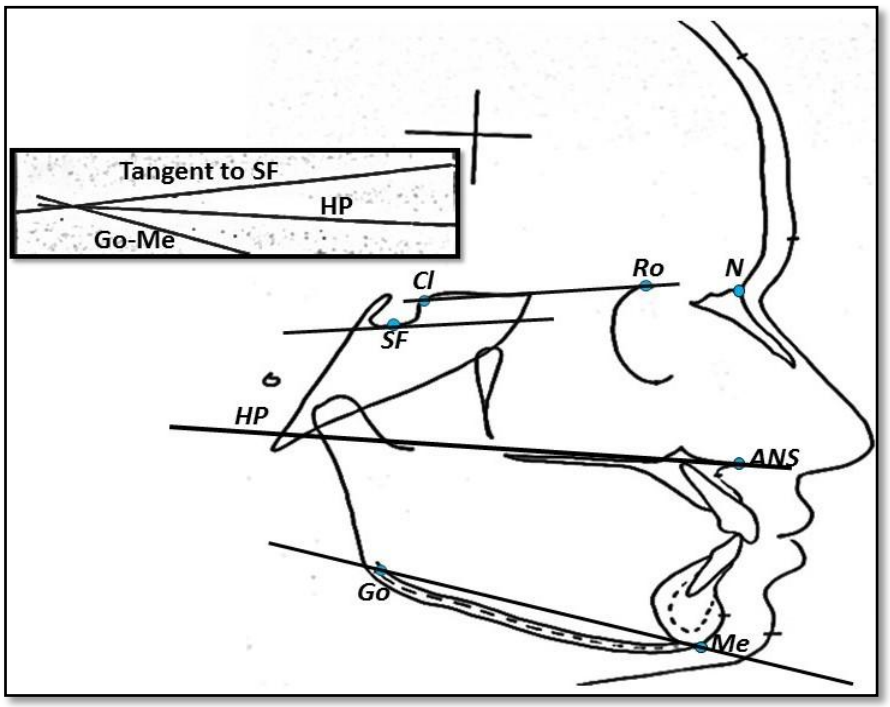

Fig. 3: Horizontal Plane

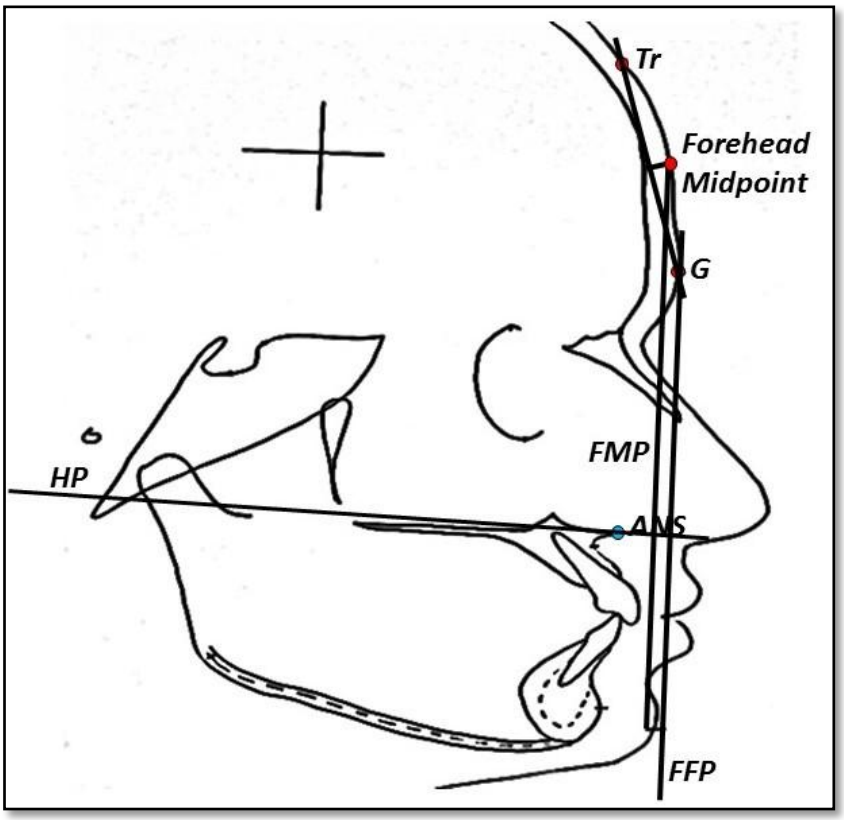

Fig. 4: Forehead Facial AndMidpoint Plane

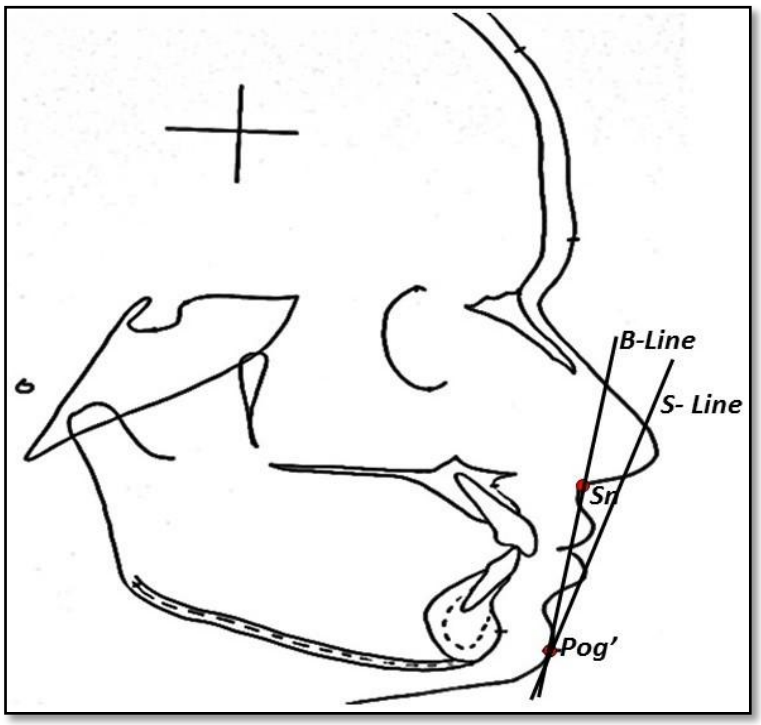

Fig. 5:S-Line AndB-Line

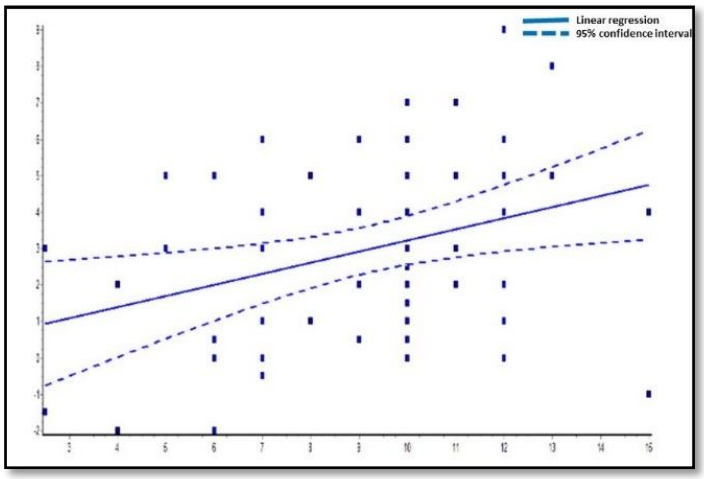

Fig.6:N-Pog To Upper Lip

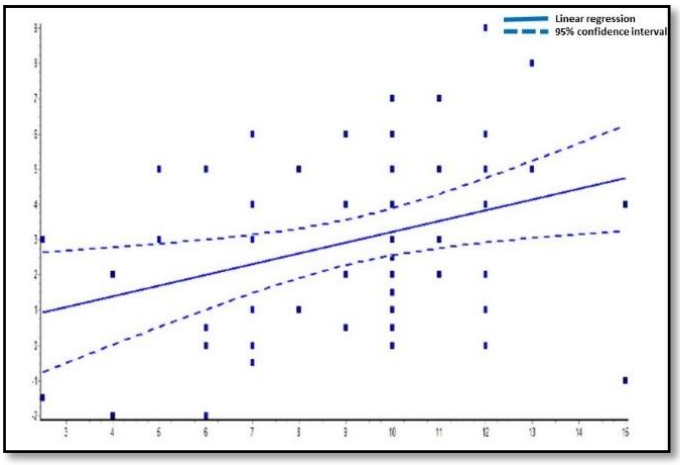

Fig.7:N-Pog To Lower Lip

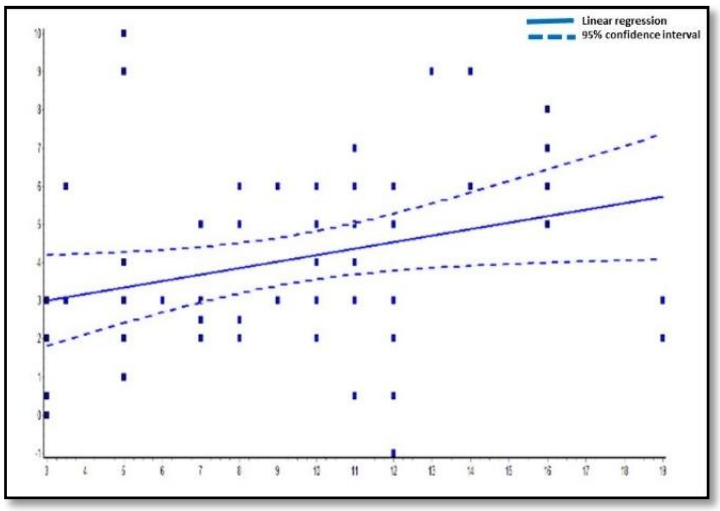

Fig.8:FFP To Lower Lip

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