IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 11 Ser.3 (November. 2023), PP 48-54
www.iosrjournals.org

Comparing The Reliability Of Steiner Stick Norms To Planned Incisor Position And Alveolar Bone Thickness In Class II Division 1 Malocclusion Using Lateral Cephalograms: A Retrospective Study.

Dr. Mithal H Patel[1], Dr. Poorya Naik Ds[2], Dr. G Shivaprakash[3]
[1](Post Graduate, Department of Orthodontics and Dentofacial Orthopedics, College of Dental sciences Davangere, India)
[2](Professor, Department of Orthodontics and Dentofacial Orthopedics, College of Dental sciences Davangere, India)
[3](Head Of Department, Department of Orthodontics and Dentofacial Orthopedics, College of Dental sciences Davangere, India)

Abstract:
Background*: In late 1920s Angle introduced his classification which was primarily focused on molar relationship. In that period the treatment of choice was generally non-extraction and expansion. In 1940s, Tweed emphasised more on extraction treatment plan and his concern was more on lower incisors position. Steiner's expressed the sagittal relation of the jaws by using ANB angle. According to him the position of upper and lower incisors changes as ANB angle changes. The thickness of the Alveolar bone and dental inclinations must be appropriate to ensure functional and aesthetic occlusion. The inclination of the teeth remains one of the six keys to Andrew's normal occlusion. It is important not only for good occlusal intercuspation but also the cortical surfaces of alveolar bone represent a limiting factor for orthodontic tooth movement beyond which fenestration and/or dehiscence might occur. Since there are no studies comparing the relationship between them, the present study was done to evaluate the Planned Incisor Position with the Alveolar Bone Thickness and its relationship to the standard Steiner Sticks norms in Pre and Post treatment Lateral cephalograms of Class II Division I Malocclusions.*
Materials and Methods*: 40 samples of Class II Division I malocclusion was selected for the study involving premolar extractions as the treatment modality. Lateral cephalograms before (T1) and after (T2) treatments were analyzed to assess the position of central incisors to alveolar bone thickness and to evaluate the correlation to the Steiner Sticks values. Variables from Steiner analysis such as ANB°, U1 to NA (in mm/deg), and L1 to NB (in mm/deg) were used along with other parameters to assess the Root position in the surrounding Alveolar bone both at pre and post treatments.*
Results*: Pre and Post treatment records of the Planned Incisor Position in relation to Steiner sticks values and Alveolar bone thickness values were compared separately. Correlation test was done using Mean values of the Steiner sticks and Alveolar bone thickness which showed the Post treatment Means of U1toNA (PIP) is highly correlated to Max (a+b) (alveolar bone thickness) by 6.2 and 8.3 respectively. The Post treatment Means of L1toNB (PIP) is highly correlated to Md (c+d) (alveolar bone thickness) by 7.0 and 9.8 respectively. p-value<0.01 suggesting that the difference is highly significant between post treatment values in both cases of U1toNA to Max (a+b) and also L1toNB to Md (c+d).*
Key Word*: Alveolar bone thickness, Lateral Cephalograms, Steiner Sticks, Planned Incisor Position.*

Date of Submission: 06-11-2023 Date of Acceptance: 16-11-2023

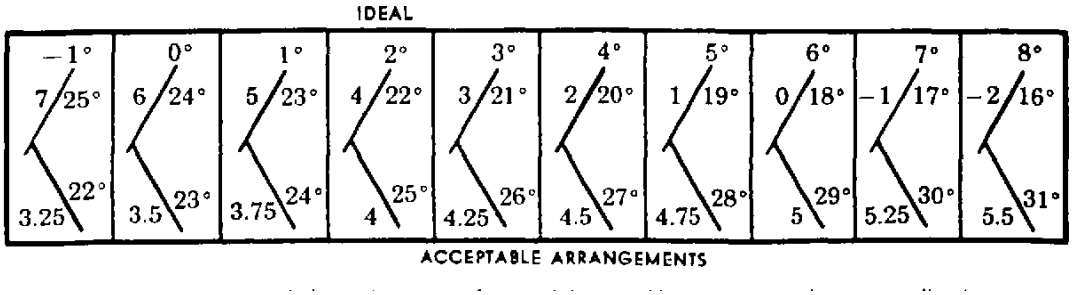
I. INTRODUCTION

In late 1920s Angle introduced his classification which was primarily focused on molar relationship. In that period the treatment of choice was generally non-extraction and expansion. In 1940s, Tweed emphasized more on extraction treatment plan and his concern was more on lower incisors position. At that time surgical correction or functional appliance was not available therefore there was more emphasis on the lower incisors, with minimized emphasis on the upper incisors[3].

Steiner's cephalometric analysis has one of its components as diagnostic tool whereby a treatment goal for an individual patient can be determined[1]. The basal discrepancies are compensated by position of the teeth

and if there is not adequate compensation of these discrepancies the position of incisors influences the position of lips.

Steiner's expressed the sagittal relation of the jaws by using ANB angle. According to him the position of upper and lower incisors changes as ANB angle changes. For 1 degree change in ANB angle 1 mm and 1 degree change in upper incisors-NA and 0.25 mm and 1 degree for lower incisor-NB is seen. Steiner acceptable compromises indicate how it is possible to adjust the position of the upper and lower incisors to the size of the ANB angle and at the same time maintain a normal over jet and overbite.



The thickness of the Alveolar bone and dental inclinations must be appropriate to ensure functional and aesthetic occlusion. The inclination of the teeth remains one of the six keys to Andrew's normal occlusion. It is important not only for occlusal intercuspation but also for the aesthetics of the frontal smile[6].

The cortical surfaces of alveolar bone represent a limiting factor for orthodontic tooth movement beyond which fenestration and/or dehiscence might occur. Induced contact between incisor roots and alveolar cortical bone can also precipitate external root resorption.

In this study, the positions of Maxillary and Mandibular Central Incisors were assessed using Lateral cephalograms. Their long-axis inclination as well as the AP position of the roots with respect to surrounding alveolar bone was evaluated.

The aim of this study was to correlate the relationship of Steiner Sticks norms with the Central Incisor Root Position in the Alveolar bone thickness in class II Division I malocclusion. The null hypothesis was that there would be no correlation between the Steiner Stick norms and Planned Incisor Position with Alveolar Bone Thickness in pre and post treatment lateral cephalograms of Class II Div 1 cases.

II. MATERIAL AND METHODS

Source of data: The Lateral cephalograms of Class II Division I was chosen from the archives of the Department of Orthodontics and Dentofacial Orthopedics, College of Dental Sciences, Davangere.

Sampling: 40 samples were selected for pre and post treatment Lateral cephalograms of class II Division I malocclusion with ANB ranging from 3° to 10°.

Inclusion criteria

1. Samples were selected with age group ranging from 18-35 years of age.
2. A full complement of erupted permanent teeth (not necessarily third molars).
3. Angle's Class II malocclusion with ANB ranging from 3^0-10^0 and samples with extraction protocol of either first or second premolar cases.

Exclusion criteria

1. No history of systemic diseases, syndromes or severe facial deformities or symptoms of TMJ joint disorders.
2. Periodontal compromised dentition.

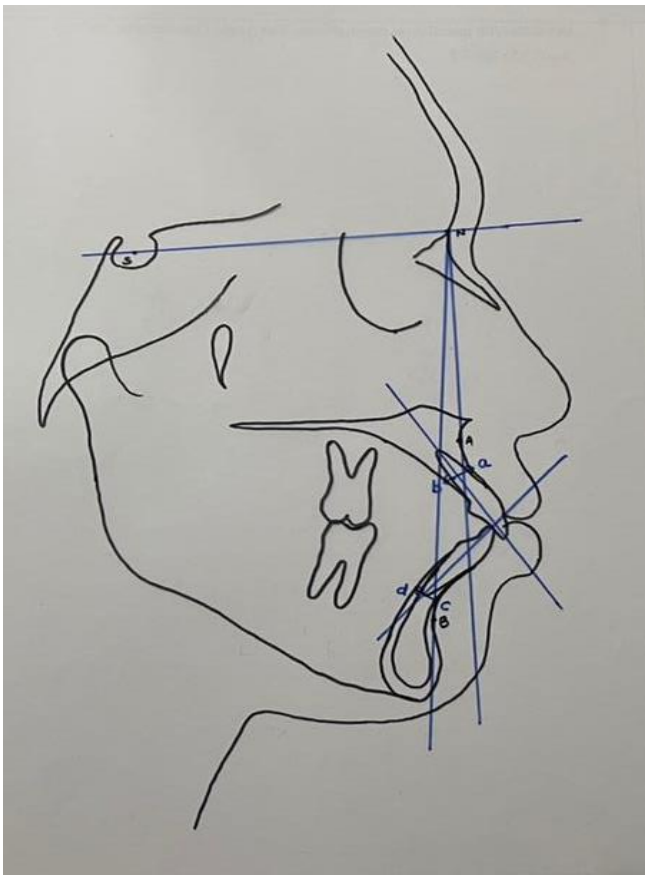
Methodology

1. The Lateral cephalometric radiographs for both pre and post treatment stages were taken using the Natural Head Position, standard Cephalostat (120 KV, 10mA) and cephalometric magnification of 107%.
2. Samples were identified based on selection criteria. The Lateral cephalograms were hand traced using matte finish 0.003" acetate paper and pencil of 0.35mm.
3. Various landmarks, reference planes, and linear and angular measurements were used to comparatively evaluate the differences in samples.

Parameters used

- **SNA** = Angle between SN plane and NA line. This angle helps determine if maxilla is positioned anteriorly or posteriorly to the cranial base.

- **SNB** = Angle between SN plane and NB line. This angle helps determine if mandible is positioned anteriorly or posteriorly to the cranial base.
- **ANB** = Angle between NA and NB line. This angle helps determine the relationship between maxilla and mandible to each other.
- **Maxillary Incisor inclination (U1-NA)** = Relationship of maxillary central incisor to the NA line. Average is 22^0 and 4mm.
- **Mandibular Incisor inclination (L1-NB)** = Relationship of mandibular central incisor to the NB line. Average is 25^0 and 4mm.
- **Maxillary central incisor root position** = Distance (in mm) from the root midpoint to the outer cortical surface of alveolar process on Labial (a) and Palatal (b) sides were measured perpendicular to the long axis of the tooth.
- **Mandibular central incisor root position** = Distance (in mm) from the apex to the outer cortical surface of alveolar process on Labial (c) and Lingual (d) sides were measured perpendicular to the long axis of the tooth.
- **Maxillary Alveolar bone thickness (a+b)** = the total maxillary alveolar thickness (MX-ALV) was calculated by adding distances (a+b).
- **Mandibular Alveolar bone thickness (c+d)** = the total mandibular alveolar thickness (MD-ALV) was calculated by adding distances (c+d).



Statistical analysis

Paired T-test was used to evaluate the difference between the variables in Pre and Post treatment values of Steiner stick norms, planned incisor position and Alveolar bone thickness separately.

Correlation test was used to correlate the Post treatment results of Steiner sticks values to the Alveolar bone thickness.

III. RESULT

Table no 1: Shows Pre and Post treatment records of the Steiner sticks values.
Mean values of the post-treatment U1NA mm and post-treatment L1NB mm are significantly increased by 6.17 and 7.05 respectively.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre U1toNA Deg	30.5000	40	8.06385	1.27501
	Post U1toNA Deg	24.3500	40	5.84654	.92442
Pair 2	Pre U1toNA mm	8.9750	40	2.88664	.45642
	Post U1toNA mm	6.1750	40	1.85206	.29284
Pair 3	Pre L1toNB Deg	32.8000	40	7.59960	1.20160
	Post L1toNB Deg	27.9500	40	7.52415	1.18967
Pair 4	Pre L1toNB mm	9.2250	40	2.94816	.46615
	Post L1toNB mm	7.0500	40	2.13578	.33770

Table no2: Records the Pre and Post treatment values of Central incisor inclination and Alveolar bone thickness.
The Mean values of the Post Max (a+b) and Post Md (c+d) are highly significant of 8.25 and 9.8 respectively.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre max CI RP a	3.9250	40	.79703	.12602
	Post max CI RP a	4.3500	40	.73554	.11630
Pair 2	Pre max CI RP b	4.1000	40	1.23621	.19546
	Post max CI RP b	3.9000	40	1.10477	.17468
Pair 3	Pre md CI RP c	4.7000	40	1.24447	.19677
	Post md CI RP c	5.2500	40	1.62906	.25758
Pair 4	Pre md CI RP d	4.3250	40	1.38467	.21894
	Post md CI RP d	4.6000	40	1.29694	.20506
Pair 5	Pre max (a+b)	8.0250	40	1.31046	.20720
	Post max (a+b)	8.2500	40	1.31559	.20801
Pair 6	Pre md (c+d)	9.0250	40	2.00624	.31721
	Post md (c+d)	9.8000	40	2.37724	.37588

Table no 3: Shows the overall comparisons of the Pre and Post treatment values of Steiner sticks variables, PIP and Alveolar bone thickness

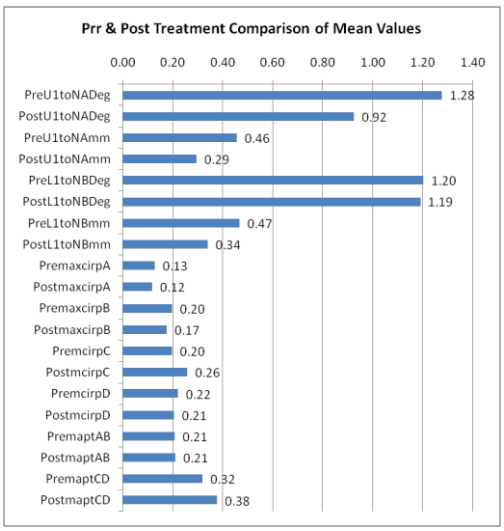


Table no 4: Shows Correlation between the Post treatment values of Steiner stick norms and associated Alveolar bone thickness

Group Statistics					
Parameters		N	Mean	Std. Deviation	Std. Error Mean
U1 to NA	Post treatment	40	6.1750	1.85206	.29284
Max (a+b)	Post treatment	40	8.2500	1.31559	.20801
L1 to NB	Post treatment	40	7.0000	2.13638	.33779
Md (c+d)	Post treatment	40	9.8000	2.37724	.37588

Table no 5: Shows Correlation Mean values of the Steiner sticks and Alveolar bone thickness. This shows that the Post treatment Means of U1toNA is highly correlated to Max (a+b) by 6.2 and 8.3 respectively. The Post treatment Means of L1toNB is highly correlated to Md (c+d) by 7.0 and 9.8 respectively.

Parameters		Mean
U1 to NA	Post treatment	6.2
Max (a+b)	Post treatment	8.3
L1 to NB	Post treatment	7.0
Md (c+d)	Post treatment	9.8

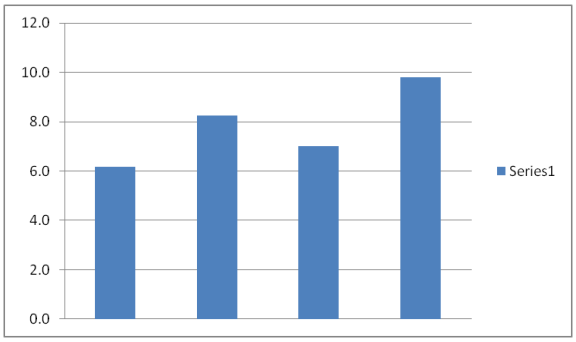


Table no 6: Shows p-value<0.01. Difference is highly significant between post treatment values in both cases of U1toNA to Max (a+b) and also L1toNB to Md (c+d).

PARAMETERS		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
U1toNA to Max(a+b)	Equal variances assumed	6.921	.010	-5.777	78	.000	-2.07500	.35920	-2.79011	-1.35989
	Equal variances not assumed			-5.777	70.370	.000	-2.07500	.35920	-2.79133	-1.35867
L1toNB to Md(c+d)	Equal variances assumed	1.240	.269	-5.541	78	.000	-2.80000	.50536	-3.80609	-1.79391
	Equal variances not assumed			-5.541	77.126	.000	-2.80000	.50536	-3.80627	-1.79373

IV. DISCUSSION

This study offered a unique and rare opportunity to evaluate the Alveolar bone thickness and its relationship to the teeth inclinations given by traditional Steiner Sticks values.

According to the results of our study, the Post treatment Means of U1toNA is highly correlated to Max a+b by 6.2 and 8.3 respectively. Similarly, the Post treatment Means of L1toNB is highly correlated to Md c+d by 7.0 and 9.8 respectively.

Steiner acceptable compromises indicate how it is possible to adjust the position of the upper and lower incisors to the size of the ANB angle and at the same time maintain a normal over jet and overbite. Find the position of the incisor that best compensates a basal sagittal discrepancy which is only indicated with positive ANB angle[3].

In the determination of the treatment goal for an individual patient according to the Steiner analysis two steps are critical. First, the clinician has to predict the change in the ANB angle and the Pg-NB distance (in mm) during treatment. Secondly, there is the question of the validity of the acceptable compromises that were proposed by Steiner and described by him as expressing the concept of a normal average American child of average age[8].

There is no reference in the literature how and where Steiner derived his mean values, and analyses from. Kowalski and Walker[9] studied the generalized ability of these norms by applying a mathematical model for the study of craniofacial morphology and growth on a large sample of 'normal' individuals and their incisal angle measurements. They showed that the assumptions inherent in establishing norms for these measurements irrespective of age and sex were tenable. Later on the Steiner cephalometric norms for other populations were also studied and they consistently differed from the Steiner reference values[10].

Planned Incisor position is generally defined as the intended end of treatment position for upper and lower incisors in the alveolar bone. Gracco et al[11] studied incisor root positions and alveolar bone thickness in untreated malocclusions and reported greater total maxillary alveolar bone thickness in short-face types than in long-face types and that maxillary incisor root apices were further from the lingual (palatal) cortex in short face types than in long face types. This could indicate that, despite increased thickness of the maxillary alveolar process in short faces, the roots remained in the anterior portion of the alveolus. This was in agreement with the findings of Nahas-Scocate et al[12] who found greater alveolar bone thickness on the palatal side of maxillary incisor roots compared with the labial side in untreated individuals.

Tian et al[13] assessed alveolar bone thickness around maxillary central incisors exhibiting varying degrees of inclination in untreated individuals and found that the midpoints of the maxillary central incisor roots were closer to the labial portion of the alveolar process than to the palatal portion. In addition, they observed less labial bone thickness in the apical region of maxillary incisors when those teeth were negatively inclined and more when positively inclined, implying that when crowns are displaced labiolingually due to environmental factors, root apices are displaced in the opposite direction with little change in the mid-root areas. Gracco et al[11] similarly observed greater thickness of labial alveolar bone in the apical region when maxillary incisor inclination increased.

Will A. Andrews et al in his study concluded that in untreated individuals, maxillary central incisors tend to occupy the anterior one-third of the maxillary alveolar process, regardless of AP jaw relationships. In untreated individuals with class I occlusions, mandibular central incisor root apices tend to be centered within the mandibular alveolar process. In untreated individuals with Class II malocclusions associated with relative mandibular retrognathia, mandibular central incisors are more positively inclined, and their root apices are more posterior than in those with untreated optimal occlusions[2].

Further, Handelman measured the labiolingual alveolar bone thickness of the maxillary central incisors and found that the proclination of the tooth was inversely correlated with the apex to labiolingual alveolar bone thickness. The results of this study also revealed that the smaller the apical alveolar bone thickness, the higher the probability of alveolar bone defects[7].

In general, a thorough assessment of Planned Incisor position and the alveolar bone thickness of the teeth is necessary to determine the limits of possible dental movement during orthodontic treatment. Dental displacement is the basis of orthodontic therapy. It is the result between the application of a force to a tooth and the strength of its supporting tissues. Knowledge of alveolar bone volume can help orthodontists to better control the forces applied to avoid iatrogenic bone loss and bone fenestration[6].

When dental orthodontic movements are planned, the position of the roots of the teeth in the surrounding alveolar bone is planned as equally important as Steiner Sticks values for teeth inclinations post-treatment, considering it as "Diagnosis" variables.

This study highlights that for a proper Orthodontic treatment planning and outcome of the results, the traditional way of Steiner stick norms are not the only thing to be considered but also the Alveolar bone thickness surrounding the Central incisor positions.

V. CONCLUSION

Steiner sticks acceptable compromises indicates how it is possible to adjust the position of Upper and Lower incisors to the size of ANB angle and the same time maintain normal overjet and overbite. Similarly the Central Incisor inclination with the Alveolar bone thickness must be appropriate to ensure functional and esthetic occlusion Post treatment and to prevent the future periodontal involvement.

For a proper Orthodontic treatment planning and better outcome of the results, not only Steiner sticks values have to be considered, but also the associated Alveolar bone thickness to be considered equally important.

ACKNOWLEDGEMENTS

This project represents the assistance and efforts of many individuals. We would like to acknowledge Head of the Department for providing access to the departmental records needed for our study and the statistician who made us to complete this project successfully.

REFERENCES

[1]. Servoss JM. The Acceptability Of Steiner's Acceptable Compromises. American Journal Of Orthodontics. 1973 Feb 1;63(2):161-5.
[2]. Andrews WA, Abdulrazzaq WS, Hunt JE, Mendes LM, Hallman LA. Incisor Position And Alveolar Bone Thickness: A Comparative Analysis Of Two Untreated Samples Using Lateral Cephalograms. The Angle Orthodontist. 2022 Jan;92(1):3-10.
[3]. Jain S, Vibhute P, Patil C, Umale V, Balagangadhar, Et Al. (2020) 3D Planning Strategies Of Maxillary And Mandibular Incisor Position Before Starting The Orthodontic Treatment. J Oral Health Dent, 3(1): 179-184.
[4]. Abdullah RT, Kuijpers MA, Bergé SJ, Katsaros C. Steiner Cephalometric Analysis: Predicted And Actual Treatment Outcome Compared. Orthodontics & Craniofacial Research. 2006 May;9(2):77-83.
[5]. Sheng Y, Guo HM, Bai YX, Li S. Dehiscence And Fenestration In Anterior Teeth. Journal Of Orofacial Orthopaedics/Fortschritte Der Kieferorthopädie. 2020 Jan;81(1):1-9.
[6]. Beugre-Kouassi AM, Koffi BE, Beugre JB. Dental Inclination And Thickness Of The Alveolar Bone Around Incisors And Molars According To The Vertical Facial Type. Orthodontic Journal Of Nepal. 2020 Sep 4;10(1):27-31.
[7]. Handelman CS. The Anterior Alveolus: Its Importance In Limiting Orthodontic Treatment And Its Influence On The Occurrence Of Iatrogenic Sequelae. The Angle Orthodontist. 1996 Apr;66(2):95-110.
[8]. Steiner CC. Cephalometrics In Clinical Practice. The Angle Orthodontist. 1959 Jan;29(1):8-29.
[9]. Kowalski CJ, Walker GF. The Use Of Incisal Angles In The Steiner Cephalometric Analysis. The Angle Orthodontist. 1972 Apr;42(2):87-95.
[10]. Platou C, Zachrisson BU. Incisor Position In Scandinavian Children With Ideal Occlusion: A Comparison With The Ricketts And Steiner Standards. American Journal Of Orthodontics. 1983 Apr 1;83(4):341-52.
[11]. Gracco A, Lombardo L, Mancuso G, Gravina V, Siciliani G. Upper Incisor Position And Bony Support In Untreated Patients As Seen On CBCT. The Angle Orthodontist. 2009 Jul;79(4):692-702.
[12]. Nahás-Scocate AC, De Siqueira Brandão A, Patel MP, Lipiec-Ximenez ME, Chilvarquer I, Do Valle-Corotti KM. Bone Tissue Amount Related To Upper Incisors Inclination. The Angle Orthodontist. 2014 Mar;84(2):279-85.
[13]. Tian YL, Liu F, Sun HJ, Lv P, Cao YM, Yu M, Yue Y. Alveolar Bone Thickness Around Maxillary Central Incisors Of Different Inclination Assessed With Cone-Beam Computed Tomography. The Korean Journal Of Orthodontics. 2015 Sep 1;45(5):245-52.