



## Comparison Of Holdaway's Soft Tissue Analysis In Class I, Class II And Class III Skeletal Patterns In Haryana Population:A Retrospective Study

Dr. Deepankar Bhatnagar<sup>1</sup>(Professor and HOD), Dr. Hemant Garg<sup>1</sup>(Professor and Former HOD),  
Dr. Neetu Dabla<sup>1</sup>(Former Professor), Dr. Rajat Mangla<sup>1</sup>(Professor), Dr. Harjoya Khatria<sup>1</sup>(Reader),  
Dr. Naman Mittal<sup>1</sup>(Lecturer), Dr. Smaraki Mahapatra<sup>1</sup>(PG Final year student)

**\*Corresponding Author:**

**Dr. Smaraki Mahapatra**

PG final year student, Department of Orthodontics, MMCD SR, Mullana, Ambala, Haryana

Type of Publication: Original Research Paper

Conflicts of Interest: Nil

### Abstract

**Aim;-** To compare the Holdaway's soft tissue analysis in Class I, Class II and Class III skeletal patterns in Haryana population.

**Materials and method;-** Pre-treatment lateral cephalogram of 90 patients of age range 18-25 years was taken, among which it is divided into 3 groups (Class I-30, Class II-30, Class III-30). The skeletal pattern is decided according to ANB angle. ANB angle -2 to -4 degree - Skeletal Class I, >4 degree - ANB - Skeletal Class II and less than ANB angle 2 degree is Skeletal Class III. Holdaway's soft tissue analysis was done. Data was subjected to statistical analysis using SPSS software version 25.

**Results;-** The result showed that all values showing statistically significant results except upper lip strain, basic upper lip thickness, etc. All values showed statistically significant differences at 0.05 level.

**Conclusion;-** Normative values of Holdaway's soft tissue analysis for Haryana population was established.

**Keywords:** NIL

### Introduction

Smile has always been the center of every orthodontic treatment in terms of orthodontist and patient's perception. A significant shift has taken place over the years, right from hard tissue towards the soft tissue. The soft tissue paradigm has shifted detailed focus right from macro-esthetics to mini, micro, and nano esthetics, often requiring a multidisciplinary approach. Right from facial convexity to minute changes in lips and in soft tissue profile have gained paramount importance in orthodontic treatment planning<sup>1</sup>.

In 1931, Broadbent and Hoffarth, introduced the world about the cephalometric radiograph and then several skeletal analyses have been put forward by various researchers.<sup>2</sup> Due to the recent shift to soft tissue paradigm in orthodontic diagnosis and treatment planning, accurate assessment of soft tissue

structures is important. Eminent researchers like Ricketts, Merrifield, Steiner, Legan, Burstone and Arnett have contributed largely towards development of various soft tissue cephalometric analysis introducing E-line, Z-angle, S-line, COGS analysis, STCA, etc.<sup>3</sup> Since, each cephalometric study identifies different measurements as being the key to diagnosis, different treatment plans and results may be generated by examination of the same patient. In order to overcome this disparity Dr. Reed A. Holdaway, was known for the developing the soft tissue analysis, named "Holdaway's soft tissue analysis", which was developed with simplicity and directness in mind. In this analysis, Holdaway has addressed the main profile characteristics of the lower and middle third structures along with relating them to the facial upper third. One must know the racial variations during soft tissue analysis.<sup>4,5,6</sup>

### **Aims and Objectives;-**

1. To evaluate the soft tissue parameters using Holdaway analysis, for Haryana population in various Skeletal malocclusion
2. To compare soft tissue parameter values in between groups
3. To establish soft tissue profile using Holdaway's analysis

### **Materials and methodology;-**

Pre-treatment lateral ceph of 90 patients of Skeletal pattern (Class I-30,II-30, III-30) were taken from archives of Department of Orthodontics, MMCDSR Haryana. The study was approved by the ethical committee of MMCDSR. The 90 patients were divided in to 3 groups namely,

### **Groups**

1. Group I- Skeletal Class I (ANB angle 2-4 degree ,n=30)
2. Group II- Skeletal Class II (ANB angle > 4 degree, n=30)
3. Group III-Skeletal Class III (ANB angle <2 degree , n=30)

### **Inclusion criteria**

Age range should be 18-25 years.

Only pre-treatment lateral ceph was taken

Skeletal pattern was decided according to ANB angle.

### **Exclusion criteria**

Age less than 18 years and more than 25 years were not included in the study.

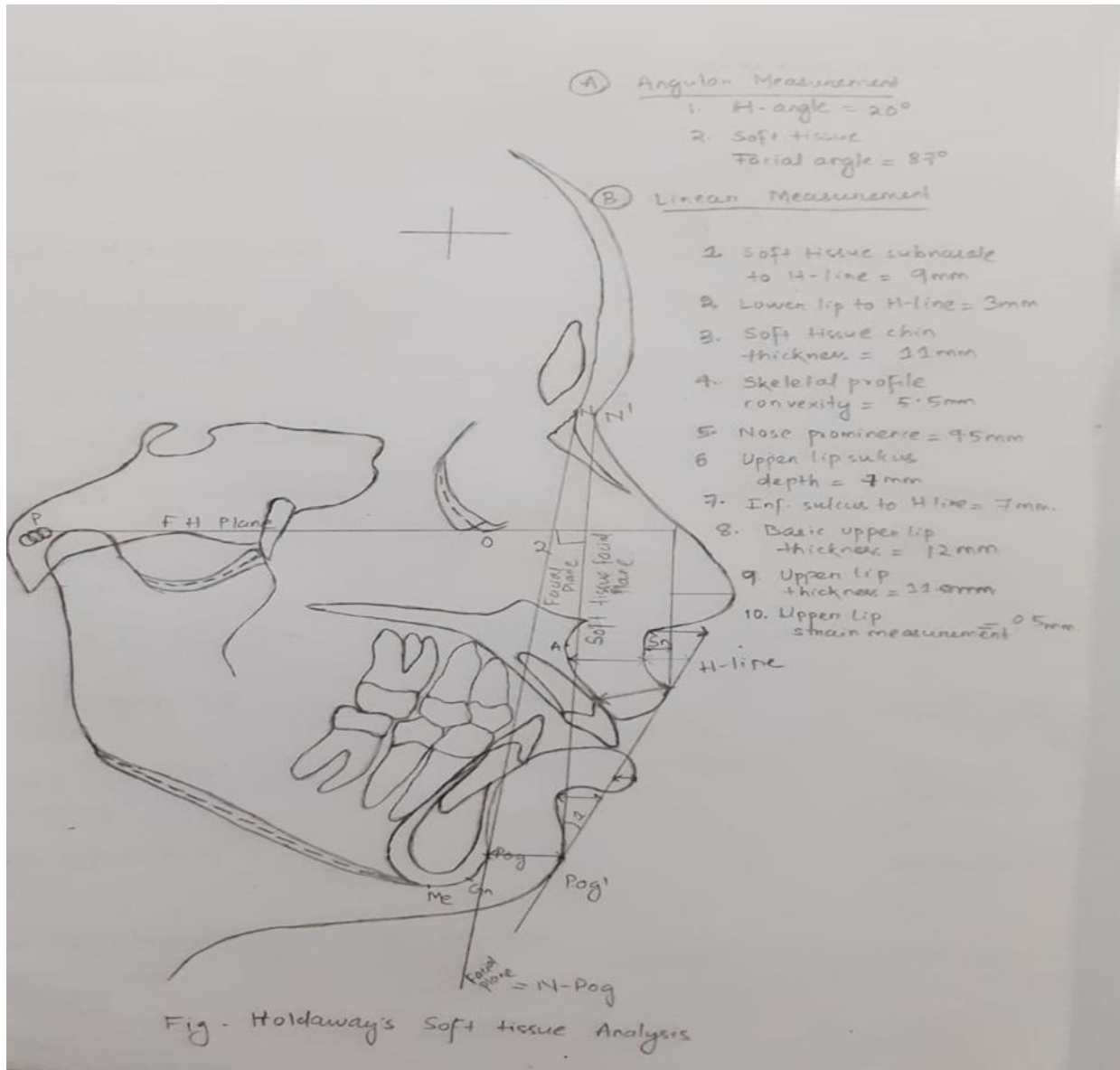
### **Methods**

Acetate matte sheets will be attached to the pre-treatment lateral ceph of patient. Holdaway's analysis was done by taking 12 parameters(10 linear and 2 angular ).10 linear and 2 angular parameters are Nose Prominence,Soft tissue subnasale to H-line ,Upper lip thickness, Basic upper lip thickness, Upper lip sulcus depth, Skeletal profile convexity, Upper lip strain, Lower lip thickness, Lower lip sulcus depth, Soft tissue chin thickness,H- angle,F-angle.(Fig.1)

### **Statistical analysis**

The data will be subjected to statistical analysis using SPSS software version 25.The stats used are descriptive statistics, ANOVA and Post-Hoc tests. ANOVA showed that all values of Holdaway was statistically significant except nose prominence, upper lip strain , etc.

**Fig.1: Holdaway's soft tissue analysis of a patient**



**Table 1:-**

		N	Mean	Std. Deviation
Nose Prominence	Class I	30	11.6500	3.54564
	Class II	30	10.3000	3.71530
	Class III	30	10.4500	3.98348
	Total	90	10.8000	3.75948

Soft tissue subnasale to H Line	Class I	30	6.8333	2.28689
	Class II	30	8.0500	3.39205
	Class III	30	4.2833	2.51438
	Total	90	6.3889	3.16297
Soft tissue chin thickness	Class I	30	11.2667	2.01603
	Class II	30	11.8667	2.82517
	Class III	30	10.3167	2.41576
	Total	90	11.1500	2.49770
Inferior sulcus to H-line	Class I	30	5.2333	1.97280
	Class II	30	6.7667	3.01929
	Class III	30	4.0000	2.46353
	Total	90	5.3333	2.74066
LL-H line	Class I	30	1.6167	2.29949
	Class II	30	1.7500	2.57558
	Class III	30	3.1667	2.59420
	Total	90	2.1778	2.56413
UL thickness	Class I	30	14.2000	2.53799
	Class II	30	13.6667	2.46819
	Class III	30	16.4000	2.60768
	Total	90	14.7556	2.77756
Basic UL thickness	Class I	30	15.6333	2.73840
	Class II	30	15.6000	2.59442
	Class III	30	17.1167	3.27920
	Total	90	16.1167	2.94047
UL sulcus depth	Class I	30	6.4500	1.67306
	Class II	30	7.9667	3.15117
	Class III	30	5.5500	3.46497
	Total	90	6.6556	3.01088
Skeletal profile convexity	Class I	30	1.9000	2.33563
	Class II	30	10.5500	3.15505
	Class III	30	8.3500	5.98727
	Total	90	6.9333	5.50699
UL strain	Class I	30	1.7000	1.51771

	Class II	30	1.9167	2.23639
	Class III	30	1.7167	1.47206
	Total	90	1.7778	1.75958
F-angle	Class I	30	91.5167	2.56798
	Class II	30	89.6833	3.71967
	Class III	30	93.3833	7.05115
H-angle	Class I	30	18.2500	2.98488
	Class II	30	22.1500	5.43797
	Class III	30	12.9667	4.47008
	Total	90	17.7889	5.77673

The table 1 shows the descriptive statistics in the above table denotes the mean and SDs for each variables in each and every variables in each Skeletal Class and also shows the mean total of each soft tissue variables of the three Skeletal Classes along with their standard deviations.

**Table-2;-**

Parameters	Sig.
Nose Prominence	.316
Soft tissue sub-nasale to H-Line	.000
Soft tissue chin thickness	.051
Inferior sulcus to H-line	.000
LL-H line	.033
UL thickness	.000
Basic UL thickness	.073
UL sulcus depth	.006
Skeletal profile convexity	.000
UL strain	.871
F-angle	.015
H-angle	.000

Table 2 denotes that each variable in Holdaway’s soft tissue analysis shows a statistically significant differences in mean values in each skeletal Classes, except lip strain ( $p=0.871$ ) and nose prominence ( $p=0.316$ ).

In the present study in Haryana population, we got that there was decreased nose prominence, increased lip strain in all skeletal groups. In Skeletal Class I and Class II group, increased upper lip prominence was seen. In Class II Skeletal group, Skeletal profile convexity, Sn-H line, upper lip sulcus depth, basic upper lip thickness was increased as compared to Holdaway’s norms. In Skeletal Class III group, increased LL (lower lip) to H-line suggested increased lower lip thickness (LLT).In Skeletal Class III group concave profile was seen. Straight

profile was seen in Skeletal Class I group and convex profile was seen in Skeletal Class II group. We finally got the Holdaway's norms for Haryana population, which is given below. Holdaway's parameters for Haryana population are hereby recommended Nose prominence (NP) =  $11 \pm 4$  mm, Soft tissue subnasale to H-line (Sn-H line) =  $6 \pm 3$  mm, Soft tissue chin thickness (Pog-Pog') =  $11 \pm 2$  mm, Inferior sulcus to H-line (Li-H line) =  $5 \pm 3$  mm, Lower lip to H-line (LL-H line) =  $2 \pm 2$  mm, Upper lip thickness (ULT) =  $15 \pm 3$  mm, Basic UL thickness =  $16 \pm 3$  mm, UL sulcus depth =  $7 \pm 3$  mm, Skeletal profile convexity =  $7 \pm 5$  mm, Upper lip strain =  $2 \pm 2$  mm, Facial angle =  $91 \pm 5$  degree, H-angle =  $18 \pm 6$  degree

## Discussion ;-

Cephalometry is a great diagnostic tool in now days in orthodontics. Various cephalometric analyses had developed since the 19<sup>th</sup> century after development of the radiographic techniques by various eminent researchers. Soft tissues along with hard tissue structures play an important role in facial esthetics. Earlier hard tissues were given more importance by the orthodontists, but the advent of various STCA-soft tissue cephalometric analysis, it became easy for the orthodontists for faster diagnosis and treatment planning. Holdaway's analysis utilized in various clinical practices and several research studies to identify the different soft tissue cephalometric findings in various ethnicities along with Holdaway's established norms in various countries.<sup>7,8,9,10,11</sup> Hence, the study was conducted in Haryana population by taking Holdaway's soft tissue cephalometric analysis in to consideration and by taking Holdaway's norms as control of study and did comparison between the three Skeletal patterns, in which Skeletal classification was decided according to ANB angle. The study was conducted in Haryana population in 90 patients, 30 of each Skeletal Class (n=30), from the year 2020 to 2022, with age range of 18-25 years.

### 1. Skeletal Convexity;-

From Table-1 The mean and SDs for Skeletal Class I group was  $1.9 \pm 2.33$  mm, showed that Skeletal Class I group has straight profile, for Class II Skeletal group it was  $10.55 \pm 3.15$  mm, showed that Class II Skeletal group has convex profile, for Class III Skeletal, it was  $8.35 \pm 5.98$  mm, showed that Class III Skeletal had concave profile. From Table-2, in ANOVA test, it revealed that statistically significant differences were found in between groups in Skeletal convexity (SK convexity) i.e.  $p=0.000$ . We got Class I has straight profile, while Class II group has convex profile and Class III group has concave facial profile.

### 2. Nose Prominence;-

From Table-1, it was found that the mean and SDs in Skeletal Class I was  $11.65 \pm 3.54$  mm, while in Skeletal Class II group it was  $10.30 \pm 3.71$  mm and for Skeletal Class III, it was  $10.45 \pm 3.98$  mm. From Table-2, it was found from ANOVA test, that there was statistically insignificant results found, while comparing between groups. In Haryana population, while comparing nose prominence with Holdaway's norms, it was seen that there was decreased nose prominence as compared to Holdaway's norms as the normal range for nose prominence for Holdaway's analysis is 14-24 mm.

### 3. Soft tissue facial angle (F-angle);-

From Table-1, it was seen that the mean and SDs for Skeletal Class I group was  $91.51 \pm 2.56$  degree, showed that normal soft tissue facial angle in Class I Skeletal group, while in Class II Skeletal group, it was  $89.6 \pm 3.71$  degree, showed that normal soft tissue facial angle in Class II Skeletal and in Class III Skeletal group,  $93.3 \pm 7.05$  degree, showed that increased soft tissue facial angle, as compared to Holdaway's norm (normal range for Holdaway's soft tissue facial angle was 84-98). From Table-2, statistically significant differences were found between groups while comparing soft tissue facial angle values, i.e.  $p=0.015$ . There was significant sex differences found within each skeletal group.

### 4. Soft tissue sub-nasale to H-line (Sn-H line);-

From (Table-1), it was seen that the mean and SDs for Class I group were  $6.83 \pm 2.28$  mm, showed that normal Sn-H line, while in Class II group it was  $8.05 \pm 3.39$  mm, showed that increased Sn-H line, because of protrusive upper lip and in Skeletal Class III group it was  $4.28 \pm 2.51$  mm, i.e. decreased as compared to Holdaway's norms (Normal = 3-7 mm), which was because of decreased upper lip prominence. In Haryana population, statistically significant differences were found in between groups in Sn-H line values i.e.  $p=0.000$  (Table 2). In Holdaway's analysis in Haryana population it was

seen that In Class I Skeletal pattern, there was normal Sn-H line, while In Class II Skeletal pattern, there was increased Sn-H line, and while in Class III Skeletal pattern, there was decreased Sn-H line .

### 5. Soft tissue Chin thickness (Pog-Pog’);-

Table-1 showed that the mean and SDs for Class I Skeletal group was  $11.26 \pm 2.01$ mm, which showed that normal soft tissue chin thickness (STCT), while in Class II Skeletal group it was  $11.86 \pm 2.82$ mm, showed that in Class III group, there was normal STCT, that was  $10.31 \pm 2.41$ mm, showed that decreased soft tissue chin thickness, as compared to Holdaway’s norm. (Normal=10-12mm). Table -2 showed that statistically significant differences in between groups i.e.  $p=0.051$ .

### 6. Lower lip sulcus depth;-

Table-1, showed that the mean and SDs for Skeletal Class I group were  $5.23 \pm 1.97$ mm, showed that lower lip sulcus depth was normal, while in Class II group it was  $6.76 \pm 3.01$ mm, showed that increased inferior sulcus depth showing deep mentolabial sulcus because of retrognathic mandible and in Class III group it was  $4.00 \pm 2.46$ mm, showed that normal lower lip or inferior sulcus depth, as compared to Holdaway’s norms (3-7mm). Statistically significant differences were found in between groups in lower lip sulcus depth values i.e.  $p=0.000$  (Table-2).

### 7. Lower lip thickness;-

Table-1 showed that mean and SDs in Skeletal Class I, II and III groups were  $1.61 \pm 2.29$ mm,  $1.75 \pm 2.57$ mm and  $3.16 \pm 2.59$ mm, respectively showed that increased lower lip thickness in Class III Skeletal group as compared to Class I and Class II Skeletal group, as compared to Holdaway’s norm (Normal=-1 to +2mm). Statistically significant differences were found in between groups in lower lip to H-line values i.e.  $p=0.033$  (Table-2).

### 8. Upper lip thickness;-

Table-1 showed that the mean and SDs of upper lip thickness (ULT) in Class I, II and Class III Skeletal group were  $14.20 \pm 2$ mm,  $13.66 \pm 2.46$ mm and  $16.4 \pm 2.60$ mm respectively, showed that increased upper lip thickness as compared to Holdaway’s norm (13-14mm) in Skeletal Class II group, because of increased upper lip prominence and prognathic maxilla in Skeletal Class II group. In Haryana

population, statistically significant values were found in between group in upper lip thickness values i.e.  $p=0.000$  (Table-2).

### 9. Basic upper lip thickness;-

Table -1 showed there was similar values of basic upper lip thickness as compared to Holdaway’s norms (Normal=15mm). In Haryana population, statistically significant values were found in between groups in basic upper lip thickness values i.e.  $p=0.073$  (Table-2). There was increased basic upper lip thickness in males in each Skeletal Class groups as compared to females. There was significant sex differences found within groups.

### 10. Upper lip sulcus depth or superior sulcus depth;-

Table-1 showed that the mean and SDs for upper lip sulcus depth were  $6.45 \pm 1.67$ mm in Skeletal Class I group, showed that normal upper lip sulcus depth, while in  $7.96 \pm 3.15$ mm and  $5.55 \pm 3.46$ mm in Skeletal Class II and III groups respectively, showed that there was increased upper lip sulcus depth in Skeletal Class II group because of prognathic maxilla and retrognathic maxilla in Class II and Class III Skeletal group respectively. In Haryana population, statistically significant differences were found in between groups while comparing upper lip sulcus depth (ULSD) values i.e.  $p=0.006$  (Table-2).

### 11. Upper lip strain;-

Table-1 showed that upper lip strain was  $1.70 \pm 1.51$ mm in Class I Skeletal group, while  $1.91 \pm 2.23$ mm and  $1.71 \pm 1.47$ mm in Class II and Class III Skeletal group respectively, showed that increased upper lip (UL) strain as compared to Holdaway’s norm (normal 0-1mm) in Class II and Class III Skeletal group, due incompetence or potentially competent lips. Statistically insignificant differences were found in between groups (Table-2).

### 12. H-angle;-

Table-1 showed that H-angle in Skeletal Class I group were  $18.25 \pm 2.98$  degree i.e. normal, while in Skeletal Class II group it was  $22.15 \pm 5.43$  degree, which was increased due to increased upper lip prominence and in Class III group it was  $12.9 \pm 4.47$  degree, showed that decreased H-angle as compared to Holdaway’s norm (7-15 degree) as Class III group had concave facial profile. Table-2 showed a

statistically significant differences found between groups.

In the present study, we are get benefited by the information that the factors affecting the soft tissue profile of the face, such as nose prominence(NP), soft tissue chin thickness(STC), lip prominence, etc. In Skeletal Class I, II population, increased in upper lip prominence, while compared to Skeletal Class III population. In Skeletal Class III population, increase in lower lip prominence was seen. Holdaway's norms for the Haryana population from the present study, which will be helpful for the orthodontist for analysis of patient's case during diagnosis and treatment planning.

#### **Limitations of study:-**

The research study can be done with increased number of sample size. Sexual dimorphism can be determined. The growth patterns of individuals can be taken in to consideration.

#### **Conclusion and Summary**

It was concluded that in Haryana population, they had decreased nose prominence, in all Skeletal Classes, increased upper lip prominence in Class I and Class II Skeletal groups, while in Class III Skeletal groups there is increased lower lip prominence, soft tissue chin thickness(STC) and decreased upper lip(UL) prominence. In Haryana population, there is less convex profile in Class I Skeletal and more convex profile in Class II Skeletal group, while concave profile in Class III Skeletal groups. The comparison between the soft tissue variable in different Skeletal patterns in Haryana population and the differences between the three Skeletal Classes in this study on Holdaway's soft tissue analysis will be helpful for the orthodontist and clinician for a better diagnosis and treatment planning for patients and to achieve their treatment goal.

#### **References**

1. Havens DC, McNamara JA, Sigler LM, Baccetti T . The role of posed smile in overall facial esthetics. *Angle Orthod.* 2010; 80: 322-328.
2. William Proffit. *Contemporary Orthodontics.* Edition,6; Publisher, Elsevier Health Sciences, 2018.
3. Enow. *The essentials of facial growth.* Edition, 2; Publisher, Needham Press, 2008.
4. Tikku T, Khanna R, Sachan K, Maurya RP, Veram G, Agarwal M. Arnett's soft tissue cephalometric analysis norms for the North Indian Population: A cephalometric study. *JIOS.* 2014; 48(4):224-232.
5. Arnett GW and Bergman RT .Facial keys to orthodontic diagnosis and treatment planning. Part I. *Am J Orthod.* 1993 April; 103(4): 299-311.
6. Holdaway RA. A soft tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. *Am J of orthod.* 1983 July; 84(1): 1-27.
7. AlBarakati SF, Bindayel NA. Holdaway soft tissue cephalometric standards for Saudi adults. *The King Saud Uni J of Dent Sci.* 2012; 3(1): 27-32.
8. Merrifield LL. The profile line as an aid in critically evaluating facial esthetics. *Am J Orthod.* 1966 Nov; 52(11): 804-21.
9. Thomas M, Reddy VD, Lakshmi HV . Soft tissue cephalometric norms for the Lambada population in Telengana region of Andhra Pradesh. *Indian J of Dental Research.* 2012;23(3):353-358.
10. Taki AA, Oguz F, Abuhileh E . Facial soft tissue values in Persian adults with normal occlusion and well balanced faces. *Angle Orthodontist.* 2009;79(3):491-4.
11. Holdaway RA. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Part-II. *AJODO.* April 1984;85(4):279-293.