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Soft Tissue Cephalometric Measurements in Skeletal Class II Division I Malocclusion with High Mandibular Plane Angel in Himachali Population

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Abstract **Original Research Article**

Aim: To evaluate the soft tissue characteristics of skeletal Class II Division 1 subjects (group II) with high mandibular plane angel compared with skeletal Class I subjects (group I) in himachali population. ***Material and Methods:*** Lateral cephalograms of 100 adults (60 women, 40 men; age range 18-50yrs) were divided into 2 groups based on horizontal and vertical skeletal pattern (SN-MP angle): group I, 50 subjects; group II-high angle (>37°), 50 subjects. The correlations and multiple linear regression tests were used to determine the skeletal and dental variables influencing soft tissue characteristics. ***Results****:* Group II-high angle showed significantly greater values than did group I for basic lower lip thickness and lower lip length. The perioral soft tissue measurements of group II were correlated with the inclination and anteroposterior position of the maxillary and mandibular incisors along with facial depth (N-Go) and facial length (S-Gn). Upper lip strain of group II was not influenced by any skeletal variables but only by the inclination and anteroposterior position of the maxillary incisors. ***Conclusions****:* It is important to evaluate lip strain and lip thickness based on the skeletal pattern as well as dental inclination to obtain balance in the perioral muscle activity.

Keywords: Soft tissue evaluation, Class II division 1 malocclusion, cephalometry.

INTRODUCTION

A proportionate relationship among different facial structures is the key to an aesthetic and pleasing facial appearance. The facial proportions of Greek gods Apollo Belvedere and Aphrodite of Melos were perceived as ideal by the sculptors [1]. These ideals of facial beauty were also considered by Angle [2]. Later on, the concepts of 'divine proportions' by Euclid and 'rule of facial thirds' by Leonardo Da Vinci helped in making ideal vertical facial proportions more of an objective phenomenon [3-4] In orthodontics, it was Sassouni who first classified facial forms into long, average and short faces according to the vertical facial dimensions. Various references of these facial patterns are found in orthodontic literature [6-8]. Since the vertical facial dimensions are closely linked to the optimum facial aesthetics, achieving the ideal vertical facial profile is among the primary objectives of orthodontic treatment [9]. This goal is usually met with the help of different growth modification appliances in growing children and with corrective jaw surgeries in the adult subjects [10, 11]. After the advent of soft tissue paradigm, various soft tissue parameters have become an integral part of the orthodontic problem list [12]. Facial aesthetics can be adversely affected if the facial soft tissues fail to follow the underlying vertical skeletal pattern; a common example of which is short upper lip in patients with vertical maxillary excess [13, 14]. Similarly, the nasolabial angle and the degree of procumbency of upper and lower lips are among other soft tissue parameters that directly influence the facial aesthetics and thus orthodontic treatment planning [15]. In past, the vertical and sagittal skeletal features of subjects with different vertical facial patterns have been extensively studied [16]. Similarly, various studies conducted on lateral cephalograms report the relationship between dento-alveolar structures and the vertical facial pattern [17, 18]. To maintain facial harmony along with occlusal excellence, it is necessary to determine the facial appearance by soft tissue analysis as well as underlying skeletal pattern in orthodontic treatment planning is necessary.

Soft tissue profiles can be influenced not only by skeletal pattern but also by dental position, and this is the focus with the characteristics of skeletal Class II Division1 in this study. Also vertical growth pattern have different effect on different facial types and is changed by growth and by orthodontic treatment. This information is properly used to erase many of the adverse changes that are happening every day. The aims of this study were to determine the characteristics of soft tissues evaluation in Himachali adults with skeletal Class II Division 1 malocclusions according to low vertical Growth patterns compared with subjects with normal occlusion in skeletal Class I and to evaluate correlation of skeletal and dental variables affecting soft tissue thickness using cephalometric analysis.

MATERIAL AND METHODS

This study was conducted in the department of Orthodontics and Dentofacial Orthopaedics. The 100 subjects were divided into two groups.

GROUP I: Skeletal class I (control group)
GROUP II: Skeletal class II division I malocclusion with low Mandibular plane angle (SN – MP >37)

The inclusion criteria for GROUP I were as follows:-

- Skeletal class I malocclusion with class I molar and class I canine relation
- Normal overjet and normal overbite
- No missing teeth except third molar
- Absence of crowding
- No alteration of facial morphology

The Inclusion Criteria for GROUP II were as Follows:

- Skeletal class II malocclusion (ANB > 4, Wits appraisal > 0 and maxillary central incisor to Sella-Nasion ,> 95) and SN/MP>37
- Class II molar and class II canine relation
- Mild crowding (arch length discrepancy <4 mm)

Lateral cephalograms were taken in natural head position and the patients were guided to close the lips in rest position. Lateral cephalograms were traced on acetate sheet. The following dental, skeletal and soft tissue measurements were done in different type of groups as shown in Table 1-3.

Table-1: Showing dental measurements done on different types of malocclusion groups

UI to SN(°)	The angle formed by Sella-Nasion and the incisor long axis
UI to NA(°)	The angle formed between the long axis of the maxillary incisor to nasion – A point lines.
UI to NA(mm)	The linear distance from the most labial surface of incisor to the Nasion – A point line
LI to NB(°)	The angle formed between the long axis of the mandibular incisor to nasion – B point line.
LI to NB(mm)	The linear distance from the most labial surface of incisor to the Nasion – B point line
IMPA	The inner angle between the long axis of the mandibular incisor and mandibular plane
Overjet(mm)	The projection of the upper anterior teeth over their antagonists in a horizontal direction when the mandible is in central relation.
Overbite(mm)	The projection of the upper anterior teeth over the lower teeth in a vertical direction when posterior teeth are in central occlusion.

Table-2: Showing skeletal measurements done on different types of malocclusion groups

SN to MP (°)	The angle formed between the anterior cranial base (S-N) to mandibular plane. (drawn between gonion(Go) and gnathion(Gn)).
FMA (°)	The angle formed between Frankfort horizontal plane and the line drawn along the lower border of mandible through constructed gonion and menton
SNA (°)	The angle between Sella-Nasion and Nasion—A point
SNB (°)	The angle formed between the Sella-Nasion and Nasion–B point Planes
ANB (°)	The difference between the SNA and SNB angles
Wits (mm)	The perpendicular lines from points A and B on to the occlusal plane. The points of contact are labeled AO and BO, respectively.
Facial length(mm)	Measured from Sella to Gnathion
Facial depth (mm)	Measured from Nasion to Gonion
Facial height ratio (%)	Ratio of Sella-Gonion to nasion-menton(S-Go/N-Me)

Table-3: Showing soft tissue measurements done on different types of malocclusion groups

Basic upper lip thickness (mm)	linear distance from 3 mm below A-point to subnasale
Upper lip thickness (mm)	Linear distance from the most prominent labial point of the maxillary incisor (U1) to labrale superius (Ls)
Upper lip strain (mm)	the difference between basic upper lip thickness and upper lip thickness
Lower lip thickness (mm)	linear distance from the most prominent labial point of the mandibular incisor (L1) to labrale inferius (Li)
Basic lower lip thickness (mm)	linear distance from B-point to the deepest point of the labiomental fold
Chin thickness-H (mm)	linear distance from pogonion to its sagittal projection on the soft tissue (Pog-Pog′)
Chin thickness-V (mm)	linear distance from menton to its vertical projection on the soft tissue (Me-Me′)
Subnasale to H-line (mm)	Linear distance from subnasale to H-line
Lower lip to H-line (mm)	Linear distance from lower lip to H-line
Ricketts' E-line-upper (mm)	Linear distance from vermilion border of upper lip to the E line
Ricketts' E-line-lower (mm)	Linear distance from vermilion border of lower lip to the E line
Upper lip length (mm)	vertical distance from subnasale to the lowest point of the upper lip (Stms) perpendicular to the Frankfort horizontal plane (FH plane)
Lower lip length (mm)	vertical distance from the highest point of the lower lip (Stmi) to the soft tissue B-point perpendicular to the FH plane
Soft tissue contour (mm)	total length of lower facial profile (subnasale-Me′)
Hard tissue contour (mm)	total length of hard tissue contour (anterior nasal spine-Me)
Contour ratio (%)	Percentage ratio of soft tissue contour to hard tissue contour;
Nasolabial angle (°)	The angle formed by the intersection of the lines tangent to the columella of the nose and the upper lip
H-angle (°)	Angle formed by H-line and soft tissue nasion-Pog0 line.

STATISTICAL ANALYSIS

SPSS version 15 computer program was used for the statistical analysis of the data. The statistical analyses included:

1. Descriptive Statistics: Mean, standard deviation (SD), minimum, and maximum values.
2. Inferential Statistics
   - 1-way analysis of variance: comparison among groups
   - Post hoc Scheff'e test: to analyze differences between the groups.

RESULTS

Table-4 Facial length (sella-gnathion) showed a significantly greater value in group I than in group II-H. Facial depth (nasion-gonion) had a lower value in group II-H than in group I. The values for L1 to NB (in millimeters and degrees) were statistically lower in group I than in groups II-H.

Table-5, For the soft tissue analysis of all subjects, basic lower lip thickness was significantly increased in group II compared with group I. Lower lip length was significantly greater for groups II-N and II-H compared with group II-L. Also, there were statistical differences between groups II-L and I in soft tissue contours, hard tissue contours, and contour ratios.

In Table-6, The thickness of the perioral soft tissue was correlated with facial depth and facial length except for upper lip length. Also, basic lower lip thickness and lower lip length were correlated with SN-MP and FMA. Basic upper lip thickness and upper lip thickness showed negative correlations with L1 to NB (degrees) with the highest coefficients. Upper lip strain showed correlations only with dental values, such as U1 to NA (millimeters and degrees), U1 to SN (degrees), and overjet. Basic upper lip thickness and basic lower lip thickness were correlated positively with most of the dental variables including L1 to NB (millimeters and degrees) and U1to NA (millimeters and degrees).

Table-4: Skeletal and dental measurements (means and standard deviations) for all subjects.

Descriptives									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
SN/MP	I	26	31.00	2.349	.461	30.05	31.95	28	35
	IIH	26	41.38	1.388	.272	40.82	41.95	40	44
FMA	I	26	26.88	1.177	.231	26.41	27.36	25	29
	IIH	26	32.15	2.327	.456	31.21	33.09	29	39
SNA	I	26	82.27	1.888	.370	81.51	83.03	79	85
	IIH	26	81.54	2.533	.497	80.52	82.56	78	85
SNB	I	26	80.12	1.505	.295	79.51	80.72	77	82
	IIH	26	76.15	2.378	.466	75.19	77.11	72	79
ANB	I	26	2.15	.613	.120	1.91	2.40	1	3
	IIH	26	5.27	.452	.089	5.09	5.45	5	6
WITTS	I	26	.92	.628	.123	.67	1.18	0	2
	IIH	26	3.00	.849	.166	2.66	3.34	2	5
FC. LEN.	I	26	130.50	4.411	.865	128.72	132.28	124	138
	IIH	26	122.81	2.743	.538	121.70	123.92	119	127
FCDEP	I	26	121.23	4.264	.836	119.51	122.95	116	128
	IIH	26	115.65	3.019	.592	114.43	116.87	109	120
FHR(%)	I	26	64.9000	11.83734	2.32149	60.1188	69.6812	8.00	70.87
	IIH	26	62.4050	.70315	.13790	62.1210	62.6890	60.94	63.78
UI/SN	I	26	104.35	1.129	.221	103.89	104.80	103	108
	IIH	26	101.27	3.341	.655	99.92	102.62	97	110
UI/NA	I	26	23.62	1.878	.368	22.86	24.37	20	26
	IIH	26	28.23	4.966	.974	26.22	30.24	20	38
UI/NA mm	I	26	5.31	.736	.144	5.01	5.60	4	6
	IIH	26	6.35	1.056	.207	5.92	6.77	5	8
LI/NB	I	26	24.69	1.828	.358	23.95	25.43	22	29
	IIH	26	29.19	1.980	.388	28.39	29.99	25	32
LI/NB mm	I	26	5.19	.895	.176	4.83	5.55	4	7
	IIH	26	7.08	.845	.166	6.74	7.42	5	8
IMPA	I	26	93.77	1.861	.365	93.02	94.52	91	97
	IIH	26	97.42	3.361	.659	96.07	98.78	89	102

Table-5: Soft tissue analysis of all subjects (means and standard deviations).

Descriptives									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
BASIC UPPER LIP THICKNES	I	26	17.15	2.222	.436	16.26	18.05	15	21
	II H	26	13.81	1.234	.242	13.31	14.31	11	16
UPPER LIP THICKNES	I	26	15.15	2.962	.581	13.96	16.35	12	20
	II H	26	12.04	.999	.196	11.63	12.44	10	14
UPPER LIP STRAIN	I	26	2.00	1.356	.266	1.45	2.55	0	5
	II H	26	1.85	.834	.164	1.51	2.18	0	3
LOWER LIP THICKNES	I	26	16.42	2.533	.497	15.40	17.45	13	21
	II H	26	16.50	.860	.169	16.15	16.85	15	18
BASIC LOWER LIP THICKNES	I	26	12.58	1.793	.352	11.85	13.30	10	15
	II H	26	14.88	1.451	.285	14.30	15.47	10	17
CHIN THICKNESS H	I	26	12.85	2.034	.399	12.02	13.67	8	16
	II H	26	13.00	1.166	.229	12.53	13.47	11	15
CHIN THICKNES V	I	26	7.62	.898	.176	7.25	7.98	6	10
	II H	26	7.54	1.029	.202	7.12	7.95	6	9
SUBSNAL H-LINE	I	26	5.42	1.629	.319	4.77	6.08	3	9
	II H	26	6.54	.647	.127	6.28	6.80	5	8
LOWER LIP H-LINE	I	26	-1.15	1.461	.287	-1.74	-.56	-4	2
	II H	26	-2.54	1.104	.216	-2.98	-2.09	-4	0
RIKKETS E-LINE UPPER	I	26	3.73	2.164	.424	2.86	4.60	0	8
	II H	26	2.31	1.934	.379	1.53	3.09	-2	4
RIKKETS E-LINE LOWER	I	26	1.04	1.800	.353	.31	1.77	-3	5
	II H	26	1.62	1.359	.266	1.07	2.16	0	4
UPPER LIP LENGTH	I	26	20.92	1.573	.308	20.29	21.56	17	23
	II H	26	21.35	1.198	.235	20.86	21.83	19	23
LOWER LIP LENGTH	I	26	17.65	1.231	.241	18.16	19.15	17	21
	II H	26	18.81	1.096	.215	18.36	19.25	17	21
SOFT TISSUE CONTOUR	I	26	74.42	2.996	.587	73.21	75.63	68	79
	II H	26	78.08	1.719	.337	77.38	78.77	75	81
HARD TISSUE CONTOUR	I	26	70.35	3.463	.679	68.95	71.75	66	76
	II H	26	75.62	1.722	.338	74.92	76.31	72	79
NASOBIAL ANGLE	I	26	106.42	7.256	1.423	103.49	109.35	95	120
	II H	26	107.42	7.420	1.455	104.43	110.42	94	117
H-ANGLE	I	26	16.31	4.389	.861	14.54	18.08	10	24
	II H	26	18.00	1.549	.304	17.37	18.63	15	22
CONTOR RATIO (%)	I	26	1.0588E2	3.18178	.62400	104.5945	107.1648	98.55	112.12
	II H	26	1.0327E2	1.37094	.26886	102.7118	103.8192	101.33	108.33

Table-6: Pearson correlation coefficients of group II between soft tissue thickness and skeletal and dental variables

		BASIC UPPER LIP THICKNES	UPPER LIP THICKNES	UPPER LIP STRAIN	LOER LIP THICKNES	BASIC LOWER LIP THICKNES	CHIN THICKNESH	CHIN THICKNESV	SUBSNAL H-LINE	LOWER LIP H-LINE	RIKKETS E-LINE UPPER	RIKKETS E-LINE LOWER	UPPER LIP LENGTH	LOWER LIP LENGTH	SOFT TISSUE CONTOUR	HARD TISSUE CONTOUR	NASOBIAL ANGLE	H-ANGLE	CONTORATIO (%)
SNMP	R	-.132	-.123	-.078	-.426*	-.358	-.096	.156	.521**	.362	.432*	.304	-.197	.193	-.401*	-.438*	-.029	-.014	.402*
	P	.520	.549	.706	.030	.073	.643	.448	.006	.069	.028	.132	.335	.344	.043	.025	.887	.944	.042
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
FMA	R	-.249	.005	-.234	-.089	-.284	.140	.233	.267	.312	.497**	.258	-.060	.041	-.188	-.347	-.123	-.014	.432*
	P	.219	.979	.249	.664	.159	.495	.251	.188	.121	.010	.204	.772	.844	.357	.082	.550	.946	.027
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
SNA	R	-.084	-.092	-.045	.102	-.387	-.056	-.316	.199	-.044	.210	-.142	.614**	-.582**	-.141	-.146	.384	.529**	.124
	P	.682	.654	.828	.619	.051	.786	.116	.329	.832	.302	.490	.001	.002	.491	.476	.052	.005	.547
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
SNB	R	-.080	-.077	-.046	.091	-.408*	-.083	-.278	.217	-.006	.289	-.081	.561**	-.548**	-.244	-.246	.413*	.479*	.208
	P	.698	.709	.823	.660	.038	.686	.169	.286	.976	.152	.696	.003	.004	.231	.225	.036	.013	.308
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
ANB	R	.019	-.049	.036	.020	.372	.218	-.072	-.240	-.229	-.657**	-.331	.000	.111	.776**	.765**	-.417*	.024	-.644**
	P	.926	.814	.862	.922	.061	.285	.728	.238	.261	.000	.098	1.000	.591	.000	.000	.034	.908	.000
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
WITTS	R	.090	.004	.082	-.002	.017	-.075	.453*	.022	.364	.607**	.453*	-.500**	.254	-.656**	-.712**	-.030	-.326	.659**
	P	.661	.983	.689	.993	.936	.716	.020	.915	.068	.001	.020	.009	.210	.000	.000	.886	.104	.000
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
FC. LEN.	R	-.156	-.018	-.139	-.326	-.242	-.261	-.297	.217	-.138	.105	-.003	-.280	.299	-.278	-.230	.192	-.533**	.164
	P	.445	.930	.498	.104	.233	.199	.140	.288	.501	.609	.988	.166	.138	.169	.258	.347	.005	.422
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
FCDEP	R	-.009	-.102	.029	.180	.507**	-.119	.167	-.644**	-.090	-.364	-.036	-.177	.075	.365	.462*	-.394*	-.308	-.473*
	P	.966	.622	.887	.378	.008	.562	.416	.000	.663	.068	.861	.386	.717	.067	.017	.047	.126	.015
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
FHR(%)	R	-.009	-.126	.039	.097	.373	.041	.057	-.288	-.179	-.600**	-.235	-.034	.060	.670**	.725**	-.540**	.076	-.668**
	P	.967	.539	.852	.638	.061	.842	.783	.153	.382	.001	.248	.869	.770	.000	.000	.004	.711	.000
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
UI/SN	R	.410*	-.087	.414*	-.287	.185	.184	-.375	-.237	.312	.212	-.255	.541**	-.597**	-.230	-.314	.133	.359	.341
	P	.037	.673	.036	.155	.366	.369	.059	.243	.120	.299	.209	.004	.001	.259	.119	.517	.072	.088
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
UI/N	R	.514	-	.50	-	.381	.057	-	-	.20	-	-	.30	-	-	-	.158	.17	.08

A		**	.081	9**	.343			.363	.334	5	.056	.270	7	.357	.147	.125		2	9
	P	.007	.694	.008	.086	.055	.782	.068	.095	.315	.786	.183	.127	.073	.475	.543	.440	.401	.667
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
UI/NA mm	R	.437*	-.293	.516**	-.557**	.177	.115	-.493*	.008	.085	-.164	-.336	.262	-.219	-.007	-.025	.018	.194	.042
	P	.025	.146	.007	.003	.387	.574	.011	.970	.679	.423	.093	.195	.282	.973	.905	.929	.343	.839
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
LI/NB	R	-.080	-.251	.018	-.301	.042	.196	.316	.069	.340	-.089	.227	.111	.032	.321	.280	-.428*	.229	-.204
	P	.699	.215	.929	.136	.839	.338	.115	.738	.089	.665	.264	.588	.876	.110	.166	.029	.260	.317
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
LI/NB mm	R	.128	-.324	.239	.005	.536**	-.020	.351	-.599**	.311	-.107	.131	.000	-.150	.238	.288	-.384	.057	-.289
	P	.533	.106	.240	.981	.005	.923	.079	.001	.122	.602	.524	1.000	.464	.242	.154	.053	.782	.152
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
IMPA	R	-.066	.143	-.114	-.208	.122	.141	.308	.133	.046	-.302	.167	-.386	.580**	.405*	.395*	-.503**	-.186	-.332
	P	.750	.487	.580	.309	.552	.492	.126	.518	.823	.134	.414	.051	.002	.040	.046	.009	.363	.097
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
INTERINCISAL	R	-.401*	-.219	-.293	.387	-.501**	.012	.188	.412*	-.246	.228	.188	-.076	.042	-.018	-.097	.149	.050	.154
	P	.042	.281	.146	.051	.009	.953	.357	.036	.226	.263	.358	.712	.839	.930	.639	.467	.808	.452
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26

DISCUSSION

The primary finding of this study states that the vertical development of facial soft tissues commensurate with the underlying vertical skeletal pattern. Subjects with long faces are likely to have long upper and lower lips and an increased total nasal height while these values are significantly reduced in subjects with short facial height. Previous studies with minor methodological differences aimed at finding the correlation between the lip heights and the underlying skeletal pattern. These studies concluded that subjects with long face are likely to have long upper and lower lips. The current study corroborates with the findings of the previous studies and adds to the literature by depicting that the vertical nasal dimensions are also significantly correlated with the underlying skeletal pattern. Previous studies have shown that the inclination of Mandibular plane affect the position of chin. Schudy and Isaacson et al concluded in a study that Mandibular plane (SN-MP) has an effect on mandibular rotation as larger the SN-MP angle, the mandible tend to become more steeper and more the chin moves backward, and vice versa [29-31].

Lee *et al.*, studied on Korean population and found that lower lip thickness was significantly greater in Class II Division 1 malocclusion with low and high Mandibular plane angle (SN-MP) compared with Class I skeletal malocclusion. In our study also lower lip thickness was significantly greater in group II compared with group I [20, 33]. In our study we found no significant difference in upper lip length between groups I and II. This is in correlation with the study done by Lee *et al.*, in Korean population.

In study done by Lee *et al.*, on Turkish population, they found that basic lower lip thickness was significantly greater in class II Division 1 with high SN-MP angle compared between Class II division 1 with low and normal SN-MP angle and Class I malooclusion [21]. Our study found no significant difference between group I and group II. This is due to the compensation of the soft tissue for the high SN-MP skeletal pattern. Blanchette *et al.*, stated that this may have been a natural phenomenon that compensates for the shorter Mandibular corpus length in order to mask the condition and providing a more normal facial appearance. Conversely the short vertical pattern showed a smaller basic lower lip thickness as a result of deficiency of vertical skeletal growth [21].

According to Holdaway[3], upper lip strain is difference between basic upper lip thickness and upper lip thickness and was useful in determining the amount of lip strain or incompetency. Holdaway suggested that the upper lip strain of 1mm or less would be acceptable and excess of it result in thinning of upper lip as it is stretched over the protrusive teeth. Therefore, we can achieve acceptable upper lip strain by controlling the incisors to eliminate the lip strain. By correlating results of group II statistically correlation was seen in upper lip strain with UI/NA (degree and mm) and UI/SN (degree). The upper lip strain observed in range (2.0±1.3, and 1. 85±0.83 mm for groups I and II) in our study groups which was influenced by proclination and saggital position of upper incisors. Thus, presumption of soft tissue change rather be based on dental characteristics of upper incisors instead of vertical pattern of mandible.

In this study we found that the value for L1 to NB (degrees) had a statistically greater value compared with group I and this might be because of the compensating effort. Lip strain needs to be evaluated carefully depending on the sagittal position of the mandibular incisors because an increased value of U1 to NA (degrees) can affect upper lip strain in Class II patients.

Within the limitations of this study, it can be concluded that perioral soft tissue characteristics of skeletal Class II Division 1 subjects showed significant differences according to sagittal and vertical skeletal patterns and were influenced by anteroposterior positions and the inclination of the incisors along with facial depth and facial length. Therefore, clinicians should evaluate lip strain and lip thickness based on the skeletal pattern as well as the dental inclination to establish the treatment objectives for a balanced facial profile.

CONCLUSIONS

- The basic lower lip thickness and lower lip length had significantly greater values in Class II Division 1 malocclusion as compared to class I skeletal malocclusion in Himachali polulation.
- The measurements of soft tissue thickness were related with the inclination and the anteroposterior position of the upper and lower incisors along with facial depth and facial length in skeletal Class II subjects.
- In the skeletal Class II subjects, upper lip strain was influenced by the inclination and the anteroposterior position of the maxillary incisors.

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