



## Establishment of Soft-Tissue Cephalometric Norms For Bengali Population Using The Arnett And Co-Workers' Analysis (STCA)

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### Abstract

**Background And Objectives:** Aim of this study was to establish lateral cephalometric norms of Arnett's STCA for Bengali population and to compare the Bengali norms with the norms of Arnett's STCA.

**Methods:** Digital lateral cephalometric radiographs of sixty young adults (thirty males and thirty females) with normal occlusion and well-balanced faces, between the age group of eighteen to twenty-four years, were obtained. Cephalometric tracings done by conventional method. The obtained values were statistically analysed to establish norms of Arnett's STCA for Bengali population.

**Results:** Significant differences between the lateral cephalometric norms were found between the Indian (Bengali) and the White samples. Significant sexual dimorphism was noted between boys and girls of the Bengali sample.

**Interpretation And Conclusion:** The result of the study indicated that ethnic differences existed between Bengali population and Caucasian population. These differences should be considered when formulating an orthodontic treatment plan for patients of Bengali origin.

**Keywords:** NIL

### Introduction

A person's ability to recognize a beautiful face is innate and can be recognized, but it is difficult to define objectively the components of this beauty. An esthetically pleasing human face is regarded as one in which the various facial features are well proportioned and balanced and relate well to the other facial features, whether viewed from front or the side. Throughout recorded history and even earlier as evidenced by archeological artifacts, human beings have been aware of and concerned about beauty and facial esthetics.<sup>1-5</sup> In the thirteenth

century, Thomas Aquinas stated a fundamental truth of esthetics: "The senses delight in things duly proportioned!" Thomas was expressing the direct and measurable relationship that exists between beauty and mathematics, a relationship that applies to both natural beauty and art.<sup>6</sup>

In the divine proportions or the Golden ratio, proposed by Fibonacci da Pisa in the twelfth century, the ratio between two esthetically proportionate parts is 1.618. In the sixteenth century, Leonardo Da Vinci is said to have applied the ratio to his paintings, including the Mona Lisa. In his art, Leonardo took

special delight in what he described as “geometric recreations”. In orthodontics, the early texts of Angle and Case bear proof that facial form and esthetics were always an important consideration of the art and science. According to Angle “...The mouth is a most potent factor in making or marring the beauty and character of the face...”. Tweed defined his concept of normal, in relation to facial contour as being “that balance and harmony of proportion considered by the majority of us as most pleasing in the human face”.<sup>6</sup>

Initial cephalometric analyses concentrate mainly on the measurement of hard tissue structures, which are not consistently related to the soft tissue of the face. Treatment based on cephalometric hard tissue norms in many instances may, in fact, create undesirable facial changes.<sup>7, 8</sup>

The advantage of soft tissue cephalometrics is that it provides the ability to make objective measurements of important structures and relationships. Soft tissue cephalometrics is a method of quantifying facial disharmony and identifying its underlying causes. In the past, a few soft tissue cephalometric analyses were developed to measure facial positions.<sup>9, 10, 11</sup> These early soft tissue analyses were not combined with clinical assessment, and none of them examined all of the important facial components. Recently, facial balance, beauty, diagnosis and treatment planning, have been improved by Dr. G.W. Arnett by means of a combination of clinical facial analysis and Soft Tissue Cephalometrics (STC).<sup>12</sup> STCA ensures objectivity by directly measuring the relative position of all facial parts involved in treatment. It also provides normal values, emphasizes soft tissue outcome, removes the subjective influence of preexisting quality, and lessens the emphasis of overjet as the sole indication of success. Facial harmony and balance are determined by the facial skeleton and its soft tissue drape. Radiographic cephalometry has been used extensively to study facial form and develop norms to aid in orthodontic diagnosis and treatment planning. Analysis of dental and skeletal patterns alone might be inadequate or misleading, because of marked variation in the soft tissue covering the dentoskeletal frame-work.

Most previous studies were routinely used to evaluate the position of the teeth in relation to the skeletal component. However, sporadic attempts were made to induce an element of soft tissue profile assessment

such as Rickett’s Esthetic plane, Holdaway analysis, Arnett and co-workers’ soft tissue cephalometric analysis (STCA). Recently, the field of orthodontics has experienced a paradigm shift to focus more on esthetics with specific emphasis on soft tissues around the mouth. Arnett and co-workers’ soft tissue cephalometric analysis (STCA) presented the facial keys to orthodontic diagnosis and treatment planning as a 3-dimensional blue print for soft tissue analysis and treatment planning.<sup>13-14</sup>

The aim of this study was

To perform Arnett and co-workers’ soft tissue cephalometric analysis [STCA] in a Bengali sample and Derive norms for the Bengali population.

To compare the soft tissue pattern of Bengali males and Bengali females.

To compare values obtained for Bengali sample using Arnett analysis with the values/norms given by Arnett for Caucasian population.

### Material And Method

Total 520 dental students were examined amongst them 60 dental students followed all the inclusion criteria so ultimately total sample size selected for the study was 60.

The samples were selected from students of Guru Nanak Institute of Dental Sciences and Research. Thirty males and thirty females non – growing Bengali dental students between 18- 24 years of age comprised the sample for this analysis.

Inclusion criteria a) Bengalis with Bengali grandparents. b) Balanced facial profile with competent lips. c) Class 1 occlusion with minimum or no crowding. d) Normal overjet and overbite. e) No history of previous orthodontic treatment. f) No history of trauma.

In preparation for the cephalometric radiograph, metallic markers in the form of small beads of Stainless steel were placed on the right side of the face, with the help of a transparent tape, to mark key midface structures (**Figure 1**). The lateral head film was obtained with the patient positioned in natural head position(**Figure 2**).<sup>15,16</sup>

All Lateral cephalometric films were traced on a transparent cellulose acetate sheet of 36µm (0.003 in) thickness. The Landmarks and measurement were

taken according to the STCA. The TVL was then established, this line was drawn through Sn and was perpendicular to the natural horizontal head position. For the projection to TVL, the horizontal distance between the various landmarks and the TVL were measured. Structures to the right of the TVL were given a positive sign and those to the left of TVL were given a negative sign.

## Results

A comparative study consisting of thirty males and thirty females was undertaken to study norms of the Indian Bengali population based on forty-five study parameters. Means, standard deviation and significance values are shown in table Normal values were calculated as mean + 2 SD for reference in the treatment procedure. Comparison of Arnett analysis values between Bengali Boys and Bengali Girls are given in **Table 1**. Comparison of values of Indian [Bengali] Population and Arnett's Original Values in boys are given in **Table 2**, Comparison of values of Indian [Bengali] Population and Arnett's Original Values – GIRLS are given in **Table 3**.

## Discussion

Our finding was discussed under the 5 heading of the STCA of Arnett et al: dentoskeletal factors(**Figure 3**), soft –tissue structure(**Figure 4**), facial lengths(**Figure 5**), projection to TVL(**Figure 6**), and facial harmony(**Figure 7**). In this analysis, natural head position was the horizontal reference. In each group, comparisons were drawn and analysed between the male and female samples and the original STCA.

Statistically significant differences between boys and girls were found in Maxillary Incisor to Maxillary Occlusal Plane angle. both at ( $P < 0.005$ ), the values being greater in boys. All the Soft tissue thicknesses i.e., Upper Lip Thickness, Lower Lip Thickness, Upper lip angle ( $P < 0.01$ ) and Hard Tissue Pogonion to Soft Tissue Pogonion at ( $P < 0.005$ ) were significantly greater in boys as compared to girls. Nasolabial angle was greater in girls. Facial lengths i.e.,rd.

Upper Lip Length, Lower Lip Length, Lower 1/3 of face, Maxillary Height, Mandibular

Height ( $P < 0.005$ ) and Total Facial Height (Nasion' – Menton') ( $P < 0.005$ ) were significantly greater in boys. Scheideman et al also reported that increased lower face height in male subject. The Maxillary

Incisor Exposure ( $P < 0.01$ ) and Interlabial gap ( $P < 0.005$ ) were greater in girls. The midface metallic markers namely Orbital rim, Cheek bone and Subpupil ( $P < 0.005$ ) show significant deviation from the TVL in boys. For the girls, the distance from TVL to midface metallic markers is less indicating more prominence of midface region in girls as compared to boys. The maxillary and mandibular incisors were closer to TVL in girls ( $P < 0.005$ ). The harmony values for boys and girls were comparable except for the relationship of orbit to jaws. In boys the values were greater than those of girls ( $P < 0.005$ ). Sn – Pogonion value was increased in girls ( $P < 0.005$ ).

The study shows that there were significant differences in values for boys of Indian origin and the original Arnett's values. In the Dentoskeletal factors Maxillary occlusal plane to TVL angle and Maxillary incisor to Maxillary occlusion plane were significant with increased values for Indian Bengali boys ( $P < 0.005$ )

The soft tissues were thicker in the boys of Indian population as compared to white population. Upper Lip Thickness, Lower Lip Thickness, Menton–Menton' ( $P < 0.005$ ) were higher in Indian boys while the Nasolabial angle was more in the sample of white population ( $P < 0.01$ ). The total facial height, mandibular height (both at  $P < 0.01$ ), the Lower 1/3rd of face, Maxillary incisor exposure and the Interlabial gap (at  $P < 0.05$ ) were greater in boys of white population. The Upper lip length, Maxillary height and Overbite (at  $P < 0.01$ ) were greater in Indian boys. The Orbital rim, Cheekbone ( $P < 0.01$ ) and Subpupil ( $P < 0.05$ ), Maxillary incisors, Mandibular incisors were more negative as compared to TVL in Indian population. Values for A point', B point', Pogonion showed that these structures were closer to TVL in the white population i.e. the white population might have protrusive dentition. Upper lip is more protrusive in white population ( $P < 0.01$ ). The chin was retrognathic as compared to TVL in Indian boys.

The comparison of harmony values suggest that Lower Lip Anterior – Pog', Orbital Rim – A Point', Mandibular incisor, facial angle are slightly significant (at  $P < 0.05$ ) and the Neck Throat Point – Pog' ( $P < 0.01$ ) distance was less in Indian [Bengali]boys.

Comparison of values of Indian Population and Arnett's Original values for girls showed that the Maxillary occlusal plane Maxillary incisor to Maxillary occlusal plane was increased in Indian girls.

The soft tissue thicknesses of, Upper lip thickness, Lower lip thickness, Menton – Menton' (P < 0.01) were more for the Indian population. Arnett's values for Nasolabial angle were more in white populations. Other values were closer to Arnett's value.

Facial lengths Nasion-Menton, Upper lip length, Interlabial gap, Lower lip length, Lower 1/3<sup>rd</sup> of face, Maxillary incisor exposure, Maxillary height and Mandibular height was greater in white population.

The Orbital rim, Cheekbone and Subpupil, Pogonion, B', Upper lip anterior (P < 0.005) were more negative as compared to TVL in Indian population. Values for B point', Maxillary incisors and Mandibular incisors (P < 0.01) showed that these structures are closer to TVL in the white population i.e., the white population might have protrusive dentition. Upper lip is more protrusive in white population (P < 0.01). The chin was retrognathic as compared to TVL in Indian girls. The nasal projection was slightly more in White girls (P < 0.05).

Among the Harmony values Mandibular incisor – Pog', Neck Throat Point – Pog' showed significant differences (P < 0.01) these values were more in White population. The angle of convexity (P < 0.05) was more in the Indian population indicating that Indian girls had a more convex profile as compared to the white girls. This study highlights the differences in facial structures of various ethnic groups. This has been reported by many authors. This study supports this conclusion. Many authors had also suggested that separate norms for distinctive populations were necessary and that not all patients could be treated to 1 set of norms. What is normal for 1 ethnic group might not be for another. Also, in various populations, differences could be seen between the sexes, and attempts both in the past and in this study were made to establish separate norms for men and women. These findings showed that group specific norms were an essential prerequisite for accurate evaluation of orthodontic patients.

## Conclusions

The soft tissue covering is unique to every person. But if we consider an ethnic group, it varies from one group to another. So establishment of norms of STCA for Bengali population was necessary which would directly influence orthodontic diagnosis and treatment planning and help the orthodontist to give better and stable post-treatment results. In the present study, beside determining the STCA values for Bengali population, sexual dimorphism is also evaluated. As the sample size is comparatively less, further study with larger sample size is required.

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**Tables:**

**Table 1: Comparison of values between Bengali Boys and Bengali Girls**

Measurements	BOYS		GIRLS		P	p
	Mean	SD	Mean	SD		
<b>Dentoskeletal factors,[DS]</b>						
<b>Maxillary occlusal plane to TVL Mx1 to occlusal plane</b>	97.06	5.79	97.93	4.16	0.005	0.004
<b>Mx1 to Md occlusal plane</b>	53.16	5.46	50.90	5.77	0.000	0.000
<b>Overjet</b>	63.2	5.59	63.50	6.55	0.299	0.608
<b>Overbite</b>	3.66	0.96	3.66	0.74	0.056	0.052
	3.68	0.99	3.90	0.83	0.055	0.053
<b>Soft tissue structures[ST]</b>						
<b>Upper lip thickness</b>	15.65	1.65	12.36	1.35	0.245	0.089
<b>Lower lip thickness</b>	16.26	1.17	12.40	1.84	0.332	0.122
<b>Pogonion-pogonion'</b>	12.05	1.75	10.81	1.89	0.289	0.225
<b>Menton- Menton'</b>	9.91	1.78	8.01	1.52	0.234	0.323
<b>Upper lip angle</b>	98.66	9.85	100.4	10.89	0.002	0.004
<b>Nasolabial angle.</b>	9.73	7.53	13.0	7.68	0.000	0.005

<b>Facial angle [FL]</b>	<b>Facial height</b>			
<b>Upper lip length</b>	<b>Interlabial gap</b>	120.38	113.46	0.000 0.000
<b>Lower lip length</b>	<b>Lower 1/3 of face</b>	4.48	4.39	0.000 0.033
<b>Overbite</b>		21.45 2.21	19.46 2.64	0.000 0.000
<b>Mx1 exposure</b>	<b>Maxillary height</b>	.1 0.20	2.18 0.78	0.000 0.004
<b>Mandibular height.</b>		47.83 3.14	44.70 3.94	0.000 0.000
		69.5 4.74	64.65 4.94	0.056 0.052
		3.6 0.90	3.91 0.81	0.003 0.000
		.94 .66	2.20 0.95	0.002 0.000
		24.66 2.69	23.60 3.32	0.000 0.000
		48.98 2.79	45.33 2.83	

**Projections to True Vertical Line**

<b>Glabella</b>	<b>Orbital rims</b>	<b>Cheek</b>	-11.50	-10.38	0.004 0.000
<b>bone</b>	<b>Subpupil</b>	<b>Alar base</b>	5.00	3.85	0.003 0.000
<b>Nasal projection</b>	<b>Subnasale</b>		-24.5 10.28	-21.96	0.20 0.002
<b>A point'</b>			-30.35	2.42	0.004 0.000
<b>Upper lip anterior</b>	<b>Maxillary</b>		2.83	-25.13	0.914 0.004
<b>incisor</b>	<b>Mandibular</b>	<b>incisor</b>	-20.58	2.80	0.002 0.001
<b>Lower lip anterior</b>	<b>B'point</b>		2.64	-17.08 2.47	0.002 0.001
<b>Pogonion'</b>			-14.10	-11.18 4.39	
			2.78	12.76 1.40	0.001 0.080
			13.41 1.97	0 0	0.209 0.004
			0 0	-1.71 1.25	0.002 0.322
			-1.53 1.10	2.35 1.95	0.003 0.033
			2.85 2.67	-8.75 2.86	0.95 0.004
			-9.65 2.41	-13.08	0.78 0.000
			-13.73	2.88	0.004 0.000
			2.91	0.44 2.80	
			1.98 3.80	-7.83 3.52	
			-7.88 2.89	-5.67 4.04	
			-5.26 3.00		

Harmony values					
Intramandibular relation M d1-pogonine'	9.05	2.94	8.25	3.34	0.003 0.003
Lower lip anterior -pogonion' B -point'-pogonion'	6.03	2.16	5.55	2.47	0.004 0.059
Throat length Interjaw relation Sn'-pogonion'	3.03	1.87	2.78	1.33	0.063 0.894
A point'- Bpoint'	52.86	5.64	52.10	4.67	0.000 0.000
Upper lip anterior-lower lip anterior	4.89	2.24	5.25	3.25	0.248 0.000
Orbit to jaws	6.36	2.55	5.73	2.89	0.375 0.087
Orbital rim'-A point' Orbital rim'-pogonion' Full facial balance Facial angle	2.48	1.54	2.66	0.95	0.235 0.087
Glabella -A'point	24.83	2.89	20.30	2.54	0.002 0.000
Glabella'- Pogonion'	20.98	4.66	16.45	4.83	0.003 0.445
	166.80		167.7	5.53	0.004 0.006
	3.90		9.45	3.33	0.004 0.005
	10.35	4.02	7.08	3.99	0.000 0.000
	8.29	4.06			

**Table 2: Comparison of values of Bengali Population and Arnett's Original Values in BOYS**

	BENGALI BOYS		ARNETT'S VALUE		P value	
	Mean (M)	S D	Mean(M)	S D		
DS1	97.06	5.79	95	1.4	0.005	S
DS2	53.16	5.46	57.8	3	0.000	S
DS3	63.2	5.59	64	4	0.299	Ns
DS4	3.66	0.96	3.2	0.6	0.056	Ns
DS5	3.68	0.99	3.2	0.7	0.055	Ns
ST1	15.65	1.65	14.8	1.4	0.245	S
ST2	16.26	1.17	15.1	1.2	0.332	S
ST3	12.05	1.75	13.5	2.3	0.289	Ns
ST4	9.91	1.78	8.8	1.3	0.234	S
ST5	98.66	9.85	106.4	7.7	0.002	S

ST6	9.73	7.53	8.3	5.4	0.000	Ns
FL1	120.38	4.48	137.7	6.5	0.000	S
FL2	21.45	2.21	24.4	2.5	0.000	S
FL3	.1	0.20	2.4	1.1	0.000	S
FL4	47.83	3.14	54.3	2.4	0.000	S
FL5	69.5	4.74	81.1	4.4	0.000	S
FL6	3.6	0.90	3.2	0.7	0.056	Ns
FL7	.94	.66	3.9	1.2	0.003	S
FL8	24.66	2.69	28.4	3.2	0.002	S
FL9	48.98	2.79	56	3	0.000	S
P-TVL1	-11.50	5.00	-8	2.5	0.004	S
P-TVL2	-24.5	10.28	-22.7	2.7	0.003	S
P-TVL3	-30.35	2.83	-25.5	4	0.000	S
P-TVL4	-20.58	2.64	-18.4	1.9	0.004	S
P-TVL5	-14.10	2.78	-15	1.7	0.914	Ns
P-TVL6	13.41	1.97	17.4	1.7	0.002	S
P-TVL7	0	0	0	0		
P-TVL8	-1.53	1.10	-0.3	1	0.001	S
P-TVL9	2.85	2.67	3.3	1.7	0.209	Ns
p-TVL10	-9.65	2.41	-12.1	1.8	0.002	S
P-TVL11	-13.73	2.91	-15.4	1.9	0.003	S
P-TVL12	1.98	3.80	1	2.2	0.95	S
P-TVL13	-7.88	2.89	-7.1	1.6	0.78	Ns
P-TVL14	-5.26	3.00	-3.5	1.8	0.004	Ns
HV1	9.05	2.94	11.5	2.8	0.003	S
HV2	6.03	2.16	4.4	2.5	0.004	S
HV3	3.03	1.87	3.5	1.3	0.063	Ns
HV4	52.86	5.64	61.4	7.4	0.000	Ns
HV5	4.89	2.24	4	1.7	0.248	Ns
HV6	6.36	2.55	6.8	1.5	0.375	Ns



HV7	2.48	1.54	2.3	1.2	0.235	Ns
HV8	24.83	2.89	21.1	3	0.002	S
HV9	20.98	4.66	18.9	2.8	0.003	S
HV10	166.80	3.90	169.4	3.2	0.004	S
HV11	10.35	4.02	7.8	2.8	0.004	S
HV12	8.29	4.06	4.6	2.2	0.000	S

**Table 3: Comparison of values of Bengali Population and Arnett’s Original Values in GIRLS**

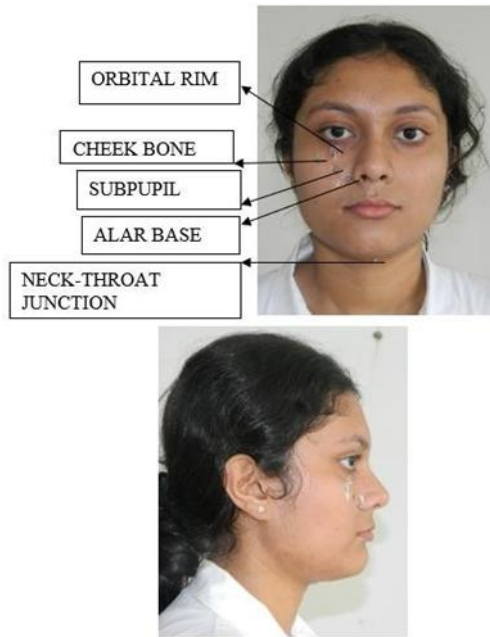
	BENGALI GIRLS		ARNETT’S VALUES		P VALUE	
	Mean(M)	SD	Mean(M)	SD		
DS1	97.93	4.16	95.6	1.8	0.004	S
DS2	50.90	5.77	56.8	2.5	0.000	S
DS3	63.50	6.55	64.3	3.2	0.608	Ns
DS4	3.66	0.74	3.2	0.4	0.052	Ns
DS5	3.90	0.83	3.2	0.7	0.053	Ns
ST1	14.36	1.35	12.16	1.8	0.089	S
ST2	15.40	1.84	13.16	1.4	0.122	S
ST3	10.81	1.89	11.8	1.5	0.225	Ns
ST4	8.01	1.52	7.4	1.6	0.323	S
ST5	100.4	10.89	103.5	6.8	0.004	S
ST6	11.0	7.68	12.1	5.1	0.005	S
FL1	113.46	4.39	124.6	4.7	0.000	S
FL2	19.46	2.64	21	1.9	0.033	S
FL3	2.18	0.78	3.3	1.3	0.000	S
FL4	44.70	3.94	46.9	2.3	0.004	S
FL5	64.65	4.94	71.1	3.5	0.000	S
FL6	3.91	0.81	3.2	0.7	0.052	Ns
FL7	2.20	0.95	4.7	1.6	0.000	S
FL8	23.60	3.32	25.7	2.7	0.000	S

FL9	45.33	2.83	48.6	2.4	0.000	S
P-TVL1	-10.38	3.85	-8.5	2.4	0.000	S
P-TVL2	-21.96	2.42	-18.7	2	0.000	S
P-TVL3	-25.13	2.80	-20.6	2.4	0.002	S
P-TVL4	-17.08	2.47	-14.8	2.1	0.000	S
P-TVL5	-11.18	4.39	-12.9	1.1	0.004	S
P-TVL6	12.76	1.40	16	1.4	0.001	S
P-TVL7	0	0	0	0		
P-TVL8	-1.71	1.25	-0.4	1	0.005	S
P-TVL9	2.35	1.95	3.7	1.2	0.004	S
P-TVL10	-8.75	2.86	-9.2	2.2	0.322	Ns
P-TVL11	-13.08	2.88	-12.4	2.2	0.003	S
P-TVL12	0.44	2.80	1.9	1.4	0.004	S
P-TVL13	-7.83	3.52	-5.3	1.3	0.000	S
P-TVL14	-5.67	4.04	-2.6	1.9	0.000	S

	BEGALI GIRLS		ARNETT'S VALUES		P VALUE	
	Mean(M)	SD	Mean(M)	SD		
HV1	8.25	3.34	9.8	2.6	0.003	S
HV2	5.55	2.47	4.5	2.1	0.059	Ns
HV3	2.78	1.33	2.7	1.1	0.894	Ns
HV4	52.10	4.67	58.2	5	0.000	S
HV5	5.25	3.25	3.2	1	0.000	S
HV6	5.73	2.89	5.2	1.6	0.087	Ns
HV7	2.66	0.95	1.8	1	0.087	Ns
HV8	20.30	2.54	18.5	2.5	0.000	S
HV9	16.45	4.83	16	2.6	0.445	Ns
HV10	167.7	5.53	169.3	3.4	0.006	Ns
HV11	9.45	3.33	8.4	2.7	0.005	S
HV12	7.08	3.99	5.9	2.3	0.000	S

**Figure**

**Figure 1: Placement of facial markers**



**Figure 2: Lateral cephalogram**



**Figure 3: Dentoskeletal factors**



**Figure 5: Facial Lengths**

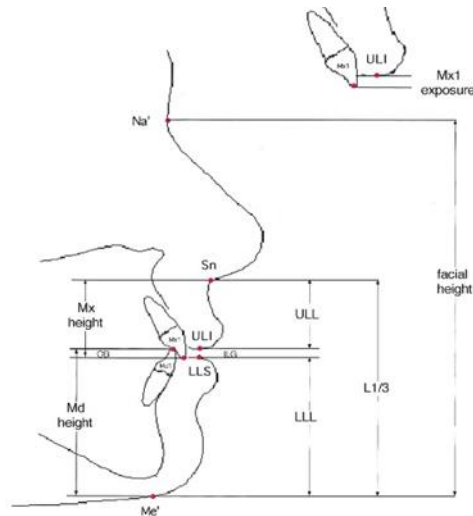


Figure 6: Projection to True Vertical Line

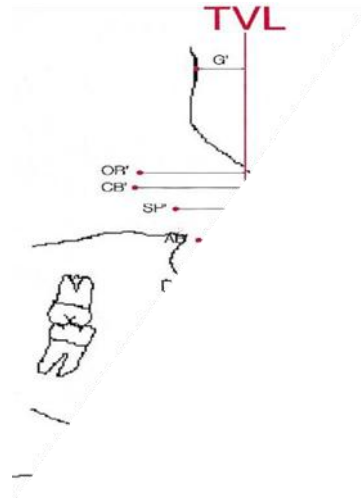


Figure 7: Harmony Values

