ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 3, Issue – 3, June - 2020, Page No. : 468 - 478

Comparative Evaluation of Video graphic Smile Dynamics In Different Skeletal Patterns Using Cephalometric Parameters

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Citation of this Article: Dr. Sharon Ann Abraham, Dr. Amrita Puri, Dr. Anil Miglani, "Comparative Evaluation of Video graphic Smile Dynamics In Different Skeletal Patterns Using Cephalometric Parameters", IJDSIR- June - 2020, Vol. – 3, Issue -3, P. No. 468– 478.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Objective: To evaluate and correlate video graphic smile dynamics with different growth patterns cephalometrically.

Material and Method: A total of 180 patients reporting to the orthodontics department ranging in age from 15–25 years were selected and divided into one of three groups—horizontal, average, and vertical skeletal pattern using cephalometric parameters in AUDAX software. Video graphic records of smile were obtained, and measurements were recorded and analyzed at rest and during smile using Photoshop Software. These cephalometric and video graphic parameters were compared for the three growth patterns as well as for sexual dimorphism.

Results: Vertical parameters were significantly increased in patients with vertical growth pattern when compared to patients with horizontal growth pattern, i.e, upper lip length, maxillary incisal display, interlabial gap, and change in upper lip length etc , whereas parameters intercommisural width, intercanine width and buccal corridor , were significantly decreased in patients with vertical growth pattern when compared to patients with horizontal growth pattern.

Conclusions: The facial growth pattern has significant influence on the parameters of smile along with definite sexual dimorphism.

Keywords: Cephalometrics, Smile dynamics, Growth pattern, Software

Introduction

The smile is an important feature of facial appearance since the attention is drawn mostly towards the eyes and mouth during social interaction[1,2]. Facial beauty is enriched by smile, which also portrays the qualities and virtues of one's personality[3.] A smile is an important part of social interaction. which projects a variety of positive emotions, such as happiness, approval, and humour. A pleasing smile is often considered a major criterion defining the success of any dental intervention, by most of the patients[4]. Due to the subjectivity of evaluation the achievement of a well-balanced smile can be challenging [5.] The re-emergence of the soft-tissue paradigm in clinical orthodontics[6] has made smile analysis and designing **key elements** in diagnosis and treatment planning[7] .The current drawback with static clinical photographs studied by the orthodontists for evaluating the existing patient's soft-tissue patterns during the treatment planning stage, was due to the subjects smiling consciously when asked to, limiting the full extent of smile parameters , reducing the actual gingival display, lip elevation , incisal display etc. This method uses videography capturing images at 30 frames per second and use of a computer software to record a smile rather than a static picture. With this method, researchers can identify a more standardized smile -greatest width, thus minimizing the inherent error of a single snapshot[8]. Smile characteristics are determined by the interplay of static and dynamic relationships between the dentoskeletal and soft tissue components of the face[9]. The purpose of this study was to investigate smile dynamics quantitatively and compare it with different skeletal patterns.

Material And Method

180 consecutive patients, of age group 15-25 years, reporting to I.T.S Dental college, Hospital and Research Centre, Greater Noida for orthodontic treatment purposes, were selected for the study. Lateral cephalograms and video were taken for all patients.

They were divided into three groups of 60 subjects ±30 males & 30 females in each group :

1. Group I- Average growth pattern
2. Group II- Horizontal growth pattern
3. Group III- Vertical growth pattern

Subjects were divided into vertical , average and horizontal growth pattern The groups were further divided into two subgroups according to sex, that is, males and females.

The video graphic set up consisted of a tripod that supported a camera NIKON D5300 DSLR and a primary flash. The subject was positioned on a line marked on the floor. The distance between the tripod and the subject was 190cm.

The natural head position was clinically achieved by asking each participant to look eye level into a mirror hung on the wall in front of the participant. The camera lens was adjusted at the level of apparent occlusal plane. The relaxed lip position was achieved by asking the participant to lick the lips and then swallow. The participants were then instructed to say their name, age and address followed by a smile. Recording began 5 second before the participant started speaking and ended after the smile. All video clips were taken by the same examiner. The digital video clips were imported into commercially available video editing software Adobe Premiere Pro CC version 7.0.0; Adobe Systems Inc., San Jose, Calif which provided individual frames that could be viewed 30 images per second.

Each frame was then analysed, the chosen frames of each participant were imported into Adobe Photoshop Adobe Photoshop CC version 7.0. 2019 and cropped, leaving only a rectangular proportionate area of 6X4 inches that contained the perioral region, and scale and measurements

were taken. Measurements were taken by drawing a line with the ruler tool, and measurements were recorded from the Measurement Log panel that appeared in the window.

Results

Data was analysed using Statistical Package for Social Sciences SPSS version 2.1. Shapiro Wilk test showed equal distribution of data.

ANOVA with Post hoc Tukeys test among both male and female subjects showed significantly increased upper lip length (at rest and during smile), interlabial gap (at rest and during smile), philtrum length, gingival zenith, gingival display, intercommisure height, upper incisal display in the vertical growth pattern subgroup, followed by average growth pattern and least amongst subjects with horizontal growth pattern. Intercommisure width and intercanine width was found to be significantly increased in horizontal growth pattern , followed by average growth pattern and least amongst vertical growth pattern subgroup.

ANOVA with independent T test amongst the growth pattern subgroups male subjects were found to have significantly increased upper lip length and upper incisal display as compared to female subjects. There was no statistically significant difference among the male and female subjects in interlabial gap. The philtrum length and inter commissure height, intercommisure width and intercanine width among male subjects with horizontal growth pattern was found to be significantly more than female subjects. Gingival zenith and gingival display among female subjects with average growth pattern was found to have statistically significant increase as compared to males.

In the Pearson Correlation test applied to the smile parameters , interlabial gap was found to be positively correlated to Upper 1 to NA , upper 1 to SN and anterior facial height and negatively to posterior facial height and jarabak ratio among females with average growth pattern. Intercommisure height is positively correlated to 1 to NA , upper 1 to SN and posterior facial height and negatively with anterior facial height among female females with average growth pattern . lower lip length was found to be positively correlated with upper 1 to NA among females with average growth pattern, Upper 1 to Sn and AFH negatively among males and females of horizontal growth pattern

Table 1: Means and Standard Deviations (SD) of Variables and Comparisons of Means Between Males and Females (P Value) Within the Three Groups by Tukey's Post Hoc Test Of Vertical Parameters

Measurements	Growth Pattern	Male Mean ± Standard Deviation	Female Mean ± Standard Deviation	P Value
ULL	Average Vertical Horizontal	23.200±1.2512 28.161±1.4537 18.502±1.4095	21.200±1.3570 25.453±1.0839 16.819±.9716	<0.0001 S
#ULL	Average Vertical Horizontal	21.053±1.3027 26.394±1.660 17.217±1.5505	19.500±1.4653 23.584±1.2139 15.286±1.0350	<0.0001 S
PL	Average	15.9789±.91626	13.7933±.88919	<0.0001 S

	Vertical	18.8111±.93046	17.5105±.93624	
	Horizontal	13.4976±.77249	12.2040±2.48758	
#PL	Average	14.463±1.1432	12.507±1.1913	<0.0001 S
	Vertical	17.206±1.0608	15.805±1.1336	
	Horizontal	12.024±1.0198	10.502±2.7303	
ICOMHT	Average	25.9895±.75784	22.6467±1.45645	<0.0001 S
	Vertical	28.5361±1.14401	26.6632±.64482	
	Horizontal	23.0268±.95943	17.9116±.78261	
#ICOMHT	Average	24.3747±1.01394	21.1973±1.62350	<0.0001 S
	Vertical	26.3833±1.27982	24.1247±1.00550	
	Horizontal	21.5995±1.06785	16.6405±1.04166	
ILG	Average	2.3974±.34605	2.4167±.76478	<0.0001 S
	Vertical	4.6289±.69892	4.5737±.59707	
	Horizontal	.8244±.70632	.7372±.51502	
#ILG	Average	7.5079±1.18863	4.7367±.64211	<0.0001 S
	Vertical	9.7333±1.16720	7.5158±.95467	
	Horizontal	3.1732±.62850	2.9140±.88737	
#GD	Average	.7947±1.07366	1.8333±1.48115	<0.0001 S
	Vertical	2.1611±2.34549	2.1211±1.98455	
	Horizontal	.4829±.91758	.6856±1.16818	
#GZ	Average	.9737±.85169	1.8067±.64083	<0.0001 S
	Vertical	2.2783±.65435	2.6658±1.27280	
	Horizontal	.7756±.96690	1.0860±.92597	
U1 DISPLAY	Average	2.3974±.34605	2.4167±.76478	<0.0001 S
	Vertical	4.6289±.69892	4.5737±.59707	
	Horizontal	.8244±.70632	.7372±.51502	
#U1 DISPLAY	Average	7.5079±1.18863	4.7367±.64211	<0.0001 S
	Vertical	9.7333±1.16720	7.5158±.95467	
	Horizontal	3.1732±.62850	2.9140±.88737	

*ULL,-upper lip length; PL-Philtrum length,#GD-Gingival display,# GZ-Gingival Zenith, ILG- interlabial gap, U1-maxillary incisal display, #ULL- change in upper lip length;#PL-change in philtrum length, #ICOMHt- change in intercommisure height .#ILG-Change in interlabial gap #U1-Change in maxillary incisal display length

Table 2: Comparisons Between the Three Groups Within Males and Females by Independent t test Of Vertical Parameters

Measurements	Growth Pattern	Gender	Mean ±Standard Deviation	N Value
ULL	Average	Male	23.200±1.2512	<0.0001 S
		Female	21.200±1.3570	
	Vertical	Male	28.161±1.4537	<0.0001 S
		Female	25.453±1.0839	
	Horizontal	Male	18.502±1.4095	<0.0001 S
		Female	16.819±.9716	
#ULL	Average	Male	21.053±1.3027	<0.0001 S
		Female	19.500±1.4653	
	Vertical	Male	26.394±1.660	<0.0001 S
		Female	23.584±1.2139	
	Horizontal	Male	17.217±1.5505	<0.0001 S
		Female	15.286±1.0350	
PL	Average	Male	15.9789±.91626	0.06, Ns
		Female	13.7933±.88919	
		Male	18.8111±.93046	
	Vertical	Female	17.5105±.93624	0.702, Ns
		Male	013.4976±.77249	
	Horizontal	Female	12.2040±2.48758	0.002, S
#PL	Average	Male	14.463±1.1432	<0.0001 S
		Female	12.507±1.1913	
		Male	17.206±1.0608	<0.0001 S
	Vertical	Female	15.805±1.1336	
		Male	12.024±1.0198	<0.0001 S
	Horizontal	Female	10.502±2.7303	
ICOMHt	Average	Male	25.9895±.75784	<0.0001 S
		Female	22.6467±1.45645	
	Vertical	Male	28.5361±1.14401	<0.0001 S
		Female	26.6632±.64482	
	Horizontal	Male	23.0268±.95943	<0.0001 S
		Female	17.9116±.78261	

#ICOMHt	Average	Male	24.3747±1.01394	<0.0001 S
		Female	21.1973±1.62350	
	Vertical	Male	26.3833±1.27982	
		Female	24.1247±1.00550	<0.0001 S
	Horizontal	Male	21.5995±1.06785	
		Female	16.6405±1.04166	<0.0001 S
ILG	Average	Male	2.3974±.34605	0.922, NS
		Female	2.4167±.76478	
	Vertical	Male	4.6289±.69892	0.797, NS
		Female	4.5737±.59707	
	Horizontal	Male	.8244±.70632	0.518, NS
		Female	.7372±.51502	
#ILG	Average	Male	7.5079±1.18863	<0.0001 S
		Female	4.7367±.64211	
	Vertical	Male	9.7333±1.16720	<0.0001 S
		Female	7.5158±.95467	
	Horizontal	Male	3.1732±.62850	<0.0001 S
		Female	2.9140±.88737	
#GD	Average	Male	.7947±1.07366	<0.0001 S
		Female	1.8333±1.48115	
	Vertical	Male	2.1611±2.34549	<0.0001 S
		Female	2.1211±1.98455	
	Horizontal	Male	.4829±.91758	<0.0001 S
		Female	.6856±1.16818	
#GZ	Average	Male	9737±.85169	<0.0001 S
		Female	1.8067±.64083	
	Vertical	Male	2.2783±.65435	<0.0001 S
		Female	2.6658±1.27280	
	Horizontal	Male	.7756±.96690	<0.0001 S
		Female	1.0860±.92597	
U1 DISPLAY	Average	Male	2.3974±.34605	
		Female	2.4167±.76478	

	Vertical	Male	4.6289±.69892	
		Female	4.5737±.59707	
	Horizontal	Male	.8244±.70632	
		Female	.7372±.51502	
#U1 DISPLAY	Average	Male	7.5079±1.18863	
		Female	4.7367±.64211	
	Vertical	Male	9.7333±1.16720	
		Female	7.5158±.95467	
	Horizontal	Male	3.1732±.62850	
		Female	2.9140±.88737	

ULL,-upper lip length; PL-Philtrum length,#GD-Gingival display,# GZ-Gingival Zenith, ILG- interlabial gap, U1-maxillary incisal display, #ULL- change in upper lip length;#PL-change in philtrum length, #ICOMHt- change in intercommisure height .#ILG-Change in interlabial gap #U1-Change in maxillary incisal display length

Table 3: Means and Standard Deviations (SD) of Variables and Comparisons of Means Between Males and Females (P Value) Within the Three Groups by Tukey's Post Hoc Test of Transverse Parameters.

Measurements	Growth Pattern	Male Mean ± Standard Deviation	Female Mean ±Standard Deviation	P Value
ICW	Average	39.0621±.69717	36.6933±2.63939	<0.0001 S
	Vertical	36.1722±1.14881	34.8842±2.01832	
	Horizontal	41.5115±2.65909	38.5209±1.20901	
ICOMW	Average	53.4589±1.76937	55.0467±.89192	<0.0001 S
	Vertical	50.6722±1.70908	47.4211±1.37703	
	Horizontal	55.4346±2.55116	56.3421±1.92816	
#ICOMW	Average	56.7747±1.25145	56.6200±.82739	<0.0001 S
	Vertical	52.6833±1.65964	49.3579±1.46223	
	Horizontal	59.6927±1.70079	59.0816±1.67995	

Table 4: Comparisons Between the Three Groups within Males and Females by Independent t test of Transverse Parameters

Measurements	Growth Pattern	Gender	Mean ±Standard Deviation	N Value
ICW	Average	Male	39.0621±.69717	0.01, S
		Female	36.6933±2.63939	
	Vertical	Male	36.1722±1.14881	0.024, S
		Female	41.5115±2.65909	
	Horizontal	Male	34.8842±2.01832	<0.0001, S
		Female	38.5209±1.20901	
ICOMW	Average	Male	53.4589±1.76937	0.003, S
		Female	55.0467±.89192	
	Vertical	Male	50.6722±1.70908	0.0952 Ns
		Female	47.4211±1.37703	
	Horizontal	Male	55.4346±2.55116	<0.0001 S
		Female	56.3421±1.92816	
#ICOMW	Average	Male	56.7747±1.25145	<0.0001 S
		Female	56.6200±.82739	
	Vertical	Male	52.6833±1.65964	
		Female	49.3579±1.46223	
	Horizontal	Male	59.6927±1.70079	
		Female	59.0816±1.67995	

ICW-Intercanine width, ICOMW-Intercommisure width,#ICOMW-Change in intercommisure width

Table 5: Pearson Correlation test applied to the smile parameterS

Measurements		Average	Vertical	Horizontal	P Value
U1to NA	ILG				
(angle)	Male	0.169	-0.087	0.041	0.489
	Female	**0.266**	-0.054	-0.246	**0.338**
	ICOMHt				
	Male	-0.026	-0.209	-0.069	0.7
	Female	**.549**	-0.295	-0.273	**.034**
U1to SN	ILG				
(angle)	Male	0.15	0.07	0.07	0.32
	Female	**0.13**	-0.04	-0.17	**0.64**
	LLL				

	Male	-0.153	-0.024	0.156	.532
	Female	.128	-0.35	**0.351**	**0.048**
PFH	ILG				
	Male	-0.28	0.06	-0.24	0.12
	Female	**-0.07**	0.017	-0.09	**0.79**
	ICOMHt				
	Male	.096	0.163	-0.149	0.351
	Female	**-0.645**	0.322	0.192	**.009**
	LLL				
	Male	.241	0.25	**-0.442**	**0.003**
	Female	-0.223	0.142	**-0.399**	**0.088**
AFH	ILG				
	Male	-0.266	0.086	-0.25	0.115
	Female	**0.09**	0.034	-0.014	**0.738**
	ICOMHt				
	Male	.097	0.182	-0.135	0.401
	Female	**-0.65**	0.327	0.175	**.009**
	LLL				
	Male	0.236	0.229	**0.456**	**0.003**
	Female	-0.170	0.145	**0.405**	**0.007**

*U1NA-Maxillary incisor to NA line angle, U1SN- Maxillary incisor to NA line angle,PFH-Posterior facial height, AFH-Anterior facial heigh

Discussion

The introduction of videography has enhanced the ability of the clinician to evaluate the smile of a patient without the errors that might occur in a single snapshot. The clinician is able to study the smile of a patient, social and entertainment. Since the video runs for a specific period of time, the patient usually presents with an entertainment smile, which gradually tapers to a social smile. The social smile which is most repeatable, is preferred over an entertainment smile.

The Photoshop CC 2019 software helps in capturing multiple frames per second of the videos of the patient, thereby helping the orthodontist in sorting out the most favourable frame for the evaluation .

In the present study, we evaluated the different linear parameters of perioral structures of patients, during rest and at widest smile position and evaluate it against different growth parameters as well as between the male and female gender.

The upper lip length, philtrum length, intercommisure height, interlabial gap, gingival display and gingival zenith was found to be increased significantly in patients with vertical growth pattern, followed by those having average growth pattern and least in horizontal growth pattern, during rest and during smile, in both males and females. Between the genders it was found to be significantly higher among the males, amongst all growth patterns uniformly.

Siddique et al[9],Grover et al[10] and Miron et al[11] found similar results in their study , with vertical variables increased amongst male patients with vertical growth pattern. Individuals with a vertical skeletal pattern have more muscular capacity to raise the upper lip than do individuals with horizontal or average patterns. A positive correlation was found between upper lip length at rest and upper lip length during smile, which implies that the longer the upper lip, the more it elevates during smile.

The results obtained by studies conducted by Tjan et al[12], Balani et al[13] and Peck et al[14] ,involving the parameters, maxillary incisal display, upper lip length, gingival display and interlabial gap are contradictory to the results achieved in our study. This discrepancy could be due to the authors taking the measurements on a still photograph with social smile, as opposed to the widest smile captured by video in our technique.

The intercanine width and intercommisure width was found to be increased significantly in subjects with horizontal growth pattern, followed by those having average growth pattern and least in vertical growth pattern, during rest and during smile, in both males and females. Between the genders it was found to be significantly higher among the males, amongst all growth patterns uniformly.

According to Prasad et al[15], strong masticatory musculature is often associated with a brachyfacial pattern. This muscular hyper-function causes an increased mechanical loading of the jaws. This in turn may cause an introduction of sutural growth and bone apposition which then results in increased transverse growth of the jaws and bone bases for the dental arches. This increase in transverse growth of jaws , increases the intercanine width, intercommisural width among the patients with horizontal growth pattern . This finding is comparable to the studies conducted by Grippaudo et al[16], Siddique et al[9], Grover et al[10].and Prasad et al[15].

Conclusion

1. Upper lip length, upper incisor display, philtrum length, intercommisure height, and gingival display increased in patients as they progressed from horizontal to vertical growth pattern.
2. Patients with horizontal growth pattern showed statistically significant increase in intercanine width and intercommisure width.
3. Male patients showed significantly increased mean in most smile parameters .

To conclude, this study found significant difference among different skeletal growth patterns on relating with hard and soft tissue smile parameters. Positive findings obtained illustrates that different skeletal growth pattern presents with significantly different smile dynamics, which could be used as a precedent for treatment planning for different facial types, and serve as a benchmark in the future for the same.

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