International Journal of Dental Research
Online ISSN: 2664-9055, Print ISSN: 2664-9047
Received: 10-01-2021, Accepted: 10-02-2021, Published: 24-03-2021
www.dentaljournal.net
Volume 3, Issue 1, 2021, Page No. 30-38

Correlation between subjective and objective evaluation of profile in class ii div 1 patient after orthodontic treatment

Glodwin Antony[1], Abhinay Sorake [2], Shetty Suhani Sudhakar [3], Nishanth Shetty[4], Mithun K Naik[5]
[1] post graduation, A.J. Institute of Dental sciences. Private Practitioner, Ernakulam, Kerala, India
[2] Reader, Department of Orthodontics, A.J. Institute of Dental Sciences, Mangalore, Karnataka, India
[3] Assistant professor, Department of Orthodontics, Srinivas Institute of Dental Sciences, Mangalore, Karnataka, India
[4] post graduation, A.J. Institute of Dental sciences. Private Practitioner, Bangalore, Karnataka, India
[5] Assistant professor, Department of Orthodontics A.J. Institute of Dental Sciences, Mangalore, Karnataka, India

Abstract
Objective: To correlate the changes in objective cephalometric measurements with changes in subjective facial esthetics in Class II Div 1 malocclusion.
Materials and Method: The sample consists of 30 class II division 1 patients with Indian origin who met the inclusion criteria. Right lateral pre and post photographs were taken and rated by panel of 10 orthodontist and 10 lay persons with the VAS score. Pre and post standardized lateral cephalograms were obtained and values were compared. The correlation between changes in facial attractiveness and cephalometric parameters were statistically analyzed.
Results: The cephalometric measurements did not directly correlate to the post treatment perceptions by the orthodontists and lay persons. The nasolabial angle, interlabial gap, lower lip to e-line and chin prominence were significant soft tissue cephalometric measurements along with a few hard tissue measurements that are U1/SN, U1-L1, U1-AP and L1-AP. Both the orthodontists and lay persons had an overall positive influence of VAS scores after orthodontic treatment but the orthodontists perceived the changes in the nose and chin more accurately as compared to the lay persons.
Conclusion: Cephalometric measurements of nose, lip position, incisor position, and chin morphology were key parameters correlated to facial esthetics and this are more accurately judged by orthodontists.

Keywords: facial esthetics; vas score; photography

Introduction

Facial aesthetics has evolved from orthodontist sculpted simple micro-esthetics of teeth to macro esthetics of face and the ways in which dentition affects the facial proportions. These facial proportions are judged as perceptions of beauty [1, 2, 3].

Orthodontics as a branch of Dentofacial Sciences can't be based on individual perceptions but on solid established objective measurements alone. Thus finding a relation between these individual subjective perceptions and established objective measurements is vital so as to develop a focused and suitable diagnosis with treatment plan as the resultant amelioration in esthetics is considered the major reason of why orthodontic treatment is sought in these times [4, 5, 6, 7].

The soft tissue profile has always played a significant role in orthodontics because appearance has a major psychosocial effect on acceptance and perceived success in society. Harmonious facial esthetics has long been recognized as a major goal of orthodontic treatment. It is important to note that up to that point in time, most of the studies dealt with skeletal analysis. It was assumed, that the soft tissue profile configuration was primarily related to the underlying skeletal configuration [8, 9]. In 1959, Subtelny indicated that the correlation between hard and soft tissue changes is not strictly a linear one. He measured horizontal and vertical facial relationships and found that not all parts of the soft tissue profile directly follow the underlying skeletal structures [10, 11, 12, 13].

Smile is one of the most important expressions contributing to facial attractiveness. Smile, defined as a facial expression characterized by upward curving of the corners of the mouth, is often used to indicate pleasure, amusement, or derision [14]. The smile, which is essential to express friendliness, agreement, and appreciation, and to convey compassion and understanding, should not be ignored in diagnosis and treatment planning. An attractive or pleasing smile enhances the acceptance of individual in the society by improving interpersonal relationships. Depending on the type of malocclusion, facial pattern of the patient and mechanics adopted, orthodontic treatment can prove either beneficial or harmful to smile esthetics. Thus, it is reasonable to regard smile analysis as an important tool for diagnosis and orthodontic treatment planning [15, 16].

Of all malocclusions, Class II division 1 malocclusions with a mandible deficiency seem to be the most prevalent both in South Indian population as well as in many races of Eurocentric societies. Facial esthetics is the most important aspect in today's orthodontic goals since our concepts have progressed from Angle Paradigm to Functional paradigm. This plays a major role in both the objective and the subjective perceptions of beauty. Therefore, improved esthetics, resulting in less convex and straighter profiles, is a treatment objective when managing such cases.

The purpose of this study was to investigate the concordance between the objective measurements of

cephalometry and the subjective, but highly reliable facial esthetics both before and after orthodontic treatment in perception of both lay people and orthodontists.

Materials and methods

The pre-treatment and post -treatment lateral cephalograms & right lateral photographs of 30 patients (males and females) clinically diagnosed with Class II div 1 malocclusion treated at Department Of Orthodontics And Dentofacial Orthopedics were collected.(figure 1)

Inclusion criteria Angles Class II div 1 molar relations, Non-growing patients. (age- 18 years and above), ANB greater than 4º, Overjet greater than 4mm.

Exclusion criteria are patients with syndromes, craniofacial anomalies, any history of dental or facial trauma, previous orthognathic surgery, previous orthodontic treatment

Standardisation of lateral cephalograms and photographs was done. The lateral cephalograms was taken using the same digital cephalostat (KODAK 8000c machine, 69 kVp, 12mA, 2 s).

Pre-treatment (T1) & post-treatment (T2) lateral cephalograms were hand traced on acetate paper by same investigator, manually to eliminate inter observer errors. Measurements were taken on the pre & post treatment cephalograms. Post treatment cephalometric measurement changes were then calculated. The photographic set up consisted of a tripod supporting a digital camera Nikon D5200. The subject was positioned on a line marked on the floor and a mirror placed 120 cm from the patient. The subject was made to look into their eyes in the mirror with their lips relaxed so that side view profile was taken in the natural head position before every recording.

Panel of 10 orthodontists and 10 lay people were shown the pre & post treatment lateral photograph of the patient and asked to score it based on the VAS method, i.e. 0 being very unpleasing and 100 being very pleasing. Post treatment photographic score changes were then calculated. Cephalometric Changes & Photographic Changes were then correlated. Study design is given in figure 2.

Results

The statistical analysis was performed by SPSS 20.0 manager, IBM SPSS statistics for Macintosh, Version 20.0, and Armonk, NY, USA. The mean and standard deviation were calculated for each variable. In the statistical evaluation of the reproducibility of the measuring system, the intraobserver consistency was calculated by intraclass coefficient (ICC). For interrelation calculations between the radiographic measurements and subjective facial esthetic scores, the Pearson correlation was applied. Quadratic regression analysis also was performed for these parameters. The significance levels used were P <.01 and P <.05.

Descriptive data regarding the characteristics of pre-treatment and post treatment cephalometric radiographs of each subject were determined and are shown in Table 1. The mean and SD are listed. The facial esthetic scores given by the professionals are shown in Table 2. The minimum, maximum, mean, and SD are listed.

Table 1 lists the Pearson correlation between the Pre and post treatment parameters and each of the 7 soft tissue cephalometric measurements. The values are listed in pairs of pre and post treatment values. It was noted that only four of them were significant statistically. These were the Nasolabial angle by -6.909, Interlabial Gap by 9.204, Lower lip to E line by -10.776 and Chin prominence by -4.284. There were definitely changes in the measurements of the other values but none statistically significant. Thus, we emphasized the subjective evaluation by the professional panel in detail.

Table 2 lists the Pearson correlation between the Pre and post treatment parameters and each of the 10 dental and skeletal cephalometric measurements. The values are also listed in pairs of pre and post treatment values. It was noted that only six of them were significant statistically. These were the mandibular plane angle by -3.067 by less significant like the L1/MP which changed by 2.160. Among the values that showed strong significance was U1/SN by -7.480, U1-L1 by -14.265, U1-AP by 11.457 and L1-AP by 5.656. The significance of some values warranted it to be correlated with the subjective VAS Scores.

The pretreatment perceptions of orthodontists and lay persons varied only on two aspects of the assessment of nose and lips where the orthodontists perceived them to be much less attractive as compared to the laypersons by -14 and -13 in scoring terms respectively. The post treatment VAS scores showed no difference statistically thereby rendering evidence that both lay persons and the orthodontists perceived the face much more similarly post orthodontic treatment.

These VAS score parameters make it an absolute necessity to solicit the correlation between the VAS Scores and the Cephalometric measurements to know the relationship between the subjective scores and how these depended on the objective values measured.

As the values for comparison suggest that irrespective of how statistically significant the differences in the pre and post treatment cephalometric values are the post treatment profile change always positively influences the VAS Scores of the orthodontist.

The statistical values in table 3 suggest positive influences on VAS scores of lay persons, athough it influences the nose and lip VAS scores weakly i.e. 0.02* & 0.002* respectively, as the perception of lay people was itself not as accurate as that of orthodontists and is much less influenced as was seen in Table 4 0.04* and 0.02* respectively.

Comparison of mean VAS scores for different parameters between Pre & Post treatment time intervals among orthodontist and Layperson using Student Paired t test is shown in Table 5 and Table 6.

Discussion

Class II Div 1 is one of the most prevalent malocclusions in south Indian population, it was taken as the centre of the study and evaluated. It has been a proven fact there is a definite change in the soft tissues post orthodontic treatment. In the early years of evolution of orthodontics, numerous articles were published on this aspect.

In the recent times, authors like Madhur Upadhyay, Sumit Yadav, K. Nagaraj and Ravindra Nanda have given sufficient evidence to demonstrate the changes in the soft tissue especially the lips which were directly influenced by incisor retraction [17]. The incisor retraction in our study also seemed to be an important parameter as it did influence the lip positions to a maximum and was recorded as U1/SN by -7.480, U1-L1 by -14.265, U1-AP by 11.457 and L1-AP by 5.656. This is supported by studies by Bishara and Jakobsen in 1995 who quoted the same with both extractions and non-extractions [18]. Daniel A. Bills, Chester S. Handelman and

Ellen A. BeGole also showed that the extraction of four premolars can be extremely successful in reducing the soft tissue procumbency seen in patients with bimaxillary protrusion [19].

The nose and lip anatomy, shape and position seem to be influenced the most in orthodontic treatment as they seem to be a part of the peri oral region. Our study suggested that the Nasolabial angle changed by -6.909, Interlabial Gap by 9.204, Lower lip to E line by -10.776 and Chin prominence by -4.284 which suggested that since these were the most significant values, the most important cephalometric changes occurred at these points thereby influencing the nose, lip profile and chin the most. For years these soft tissues have been studied and so is their influence on the profile. Just like Bowker and Merdith who studied the facial profile in 1969 metric analysis of facial profile, Spiro Choconas studied the change in the nasal profile during growth in both skeletal and soft tissue [20].

It is also of great concern that many of these soft tissue parameters are interdependent on each other, like the upper lip is closely related to nose as the nasolabial angle has a big impact on the profile. The lower lip on other hand is related to chin exclusively like shown by Faranak Modarai, Jane Catalina Donaldson and Farhad B. Nainic in a recent study of 2013 that The chin prominence observed in a progenic patient is deemed less attractive than the combined chin and lower lip prominence observed in a patient with mandibular prognathism [21]. In profiles with a more prominent chin a more protrusive lower lip position was preferred. When the chin was retrusive, a normal lower lip position was preferred to a retrusive lip which was inferred by findings of both orthodontists and lay people. Also there is the variability in lip line showing significant difference in the perceived attractiveness. Preferred lip lines as the one showing only the upper incisors in dolico and mesofacial male and female genders whereas 2 mm gum show was preferred in brachyfacial subjects according to Nabila Anwar and Mubassar Fida [22].

Esthetic perception varies from person to person and professional opinion regarding evaluation of facial esthetics may not coincide with the perceptions and expectations of patients or lay people. Earlier studies have revealed that orthodontists, general dentists, and lay people detect specific dental esthetic discrepancies at varying levels of deviation, which may aid the dental professional in making specific treatment recommendations [23, 24].

Therefore, a visual analog scale needed to be developed to measure these aesthetic perceptions. This analog scale was further tested to verify it for reliability for professional use by R. M. A. Kiekens and J. C. Maltha. A measuring system for facial aesthetics in Caucasian adolescents: reproducibility and validity [25]. The scale was found to be simple and flexible in its use, and reproducible and valid for assessing facial aesthetics. It was compared to the Q-sort method by Pedro Lima and Andrea Fonseca. Though the Q sort method was more accurate but the simplicity of VAS overcame the other advantages of Q sort method [26]. Therefore the VAS scoring system was preferred and used in the study [27]. In our study, it was found there was no doubt both in the measurements as well as the perception, though close enough still the orthodontists assessed the nose and lips more accurately as compared and scored them -14 and -13 compared to lay persons.

Perceptions are subjective which may also be influenced by a person's area of expertise especially if it has anything to do with aesthetics. The groups in our study were the most relevant groups of orthodontists and lay people. Saad Asad *et al* conducted a study on 90 subjects, with orthognathic profile as judged in consensus by orthodontist, prosthodontist, Oral Surgeon, Oral Pathologist and General Dentist and also confirmed the results using cephalograms [28]. Grant G. Coleman and Steven J. Lindauer found that preferred lip positions were generally similar among orthodontists, patients, and parents of patients, and between male and female evaluators but differences in lip positions between male and female profiles were scattered and inconsistent [29].

South Indian population as studied by Vaki Chinde and Abhishek Bansal and others like Prasanna Kumar. Exclusive Lay person studies suggest that they can reliably identify ideal smile characteristics. The ranges of acceptable deviations for smile characteristics are large, and practitioners should avoid unnecessarily sensitizing patients to minor discrepancies by A.J. Ker, Richard Chan, Henry W. Fields and Mike [30]. But when it comes to faulty smiles both orthodontists and lay people see the difference as mentioned by Vincent O. Kokich. Our study showed the same consistent results that both orthodontists and lay persons definitely assessed the faults in the profile before treatment but just that the orthodontists were much better at assessing the nose and lips.

The post treatment results of our study showed that there were positive influences on both the scores of lay people and orthodontists but the orthodontist were definitely better at assessing as they had perceived the lip and nose defects much better in the first place.

Tables and Figures

Fig 1: Pre and post treatment right lateral photograph

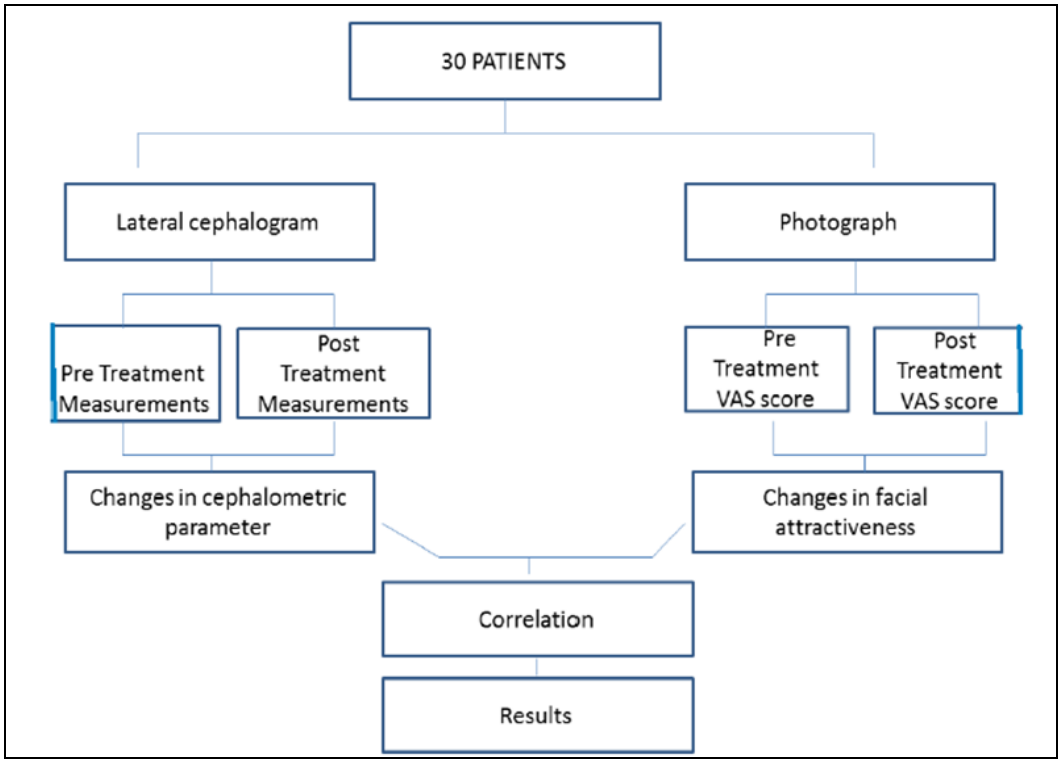

Fig 2: Study design

Table 1: Comparison of mean values of cephalometric soft tissue parameters between Pre & post treatment time intervals using Student Paired t test

Parameters	Time	N	Mean	SD	Mean Diff	t	P-Value
Facial Convexity	Pre Rx	30	20.30	2.79	0.20	0.427	0.67
	Post Rx	30	20.10	4.56			
Nose with H-Line	Pre Rx	30	1.23	1.91	-0.17	-0.595	0.56
	Post Rx	30	1.40	1.50			
Nasolabial Angle	Pre Rx	30	94.70	11.96	-12.03	-6.909	<0.001*
	Post Rx	30	106.73	6.95			
Upper lip to E-Line	Pre Rx	30	1.67	1.30	-0.23	-0.658	0.52
	Post Rx	30	1.90	1.30			
Interlabial Gap	Pre Rx	30	4.07	1.31	3.10	9.204	<0.001*
	Post Rx	30	0.97	1.25			
Lower lip to E-Line	Pre Rx	30	-3.40	1.67	-2.23	-10.776	<0.001*
	Post Rx	30	-1.17	1.51			
Chin Prominence	Pre Rx	30	-11.33	2.99	-1.53	-4.284	<0.001*
	Post Rx	30	-9.80	2.94			

Table 2: Comparison of mean values of cephalometric hard tissue parameters between Pre & post treatment time intervals using Student Paired t test

Parameters	Time	N	Mean	SD	Mean Diff	t	P-Value
ANB	Pre Rx	30	5.30	0.60	0.17	1.980	0.06
	Post Rx	30	5.13	0.63			
MPA	Pre Rx	30	28.97	6.74	-2.56	-3.067	0.005*
	Post Rx	30	31.53	6.95			
Pg - NB	Pre Rx	30	1.13	1.80	0.06	0.528	0.60
	Post Rx	30	1.07	1.87			
Y - AXIS	Pre Rx	30	65.60	2.80	-1.10	-1.823	0.08
	Post Rx	30	66.70	3.06			
OP/SN	Pre Rx	30	16.10	2.55	0.37	0.728	0.47
	Post Rx	30	15.73	2.65			
U1/SN	Pre Rx	30	61.57	7.94	-13.23	-7.480	<0.001*
	Post Rx	30	74.80	7.69			
L1/MP	Pre Rx	30	16.83	4.24	4.53	2.160	0.04*
	Post Rx	30	12.30	7.66			
U1-L1	Pre Rx	30	104.33	7.21	-18.60	-14.265	<0.001*
	Post Rx	30	122.93	5.04			
U1-AP	Pre Rx	30	12.27	1.95	5.57	11.457	<0.001*
	Post Rx	30	6.70	1.95			
L1-AP	Pre Rx	30	6.87	3.05	2.87	5.656	<0.001*
	Post Rx	30	4.00	1.82			

Table 3: Comparison of mean VAS scores for different parameters between Orthodontist & Layperson during Pre Treatment period using Independent Student t test

Parameters	Group	N	Mean	SD	Mean Diff	t	P-Value
Profile	Orthodontist	10	63.0	14.2	4.0	0.641	0.53
	Layperson	10	59.0	13.7			
Nose	Orthodontist	10	60.0	17.0	2.0	0.275	0.79
	Layperson	10	58.0	15.5			
Nasolabial	Orthodontist	10	57.0	11.6	-5.0	-1.197	0.25
	Layperson	10	62.0	6.3			
Interlabial	Orthodontist	10	61.0	12.0	0.0	0.000	1.00
	Layperson	10	61.0	12.9			
Lip	Orthodontist	10	64.0	15.1	3.0	0.454	0.66
	Layperson	10	61.0	14.5			
Chin	Orthodontist	10	67.0	13.4	2.0	0.332	0.76
	Layperson	10	65.0	15.1			

Table 4: Comparison of mean VAS scores for different parameters between Orthodontist & Layperson during Post treatment period using Independent Student t test

Parameters	Group	N	Mean	SD	Mean Diff	t	P-Value
Profile	Orthodontist	10	30.0	9.4	-5.0	-0.958	0.35
	Layperson	10	35.0	13.5			
Nose	Orthodontist	10	33.0	8.2	-14.0	-2.149	0.04*
	Layperson	10	47.0	18.9			
Nasolabial	Orthodontist	10	34.0	9.7	-7.0	-1.320	0.21
	Layperson	10	41.0	13.7			
Interlabial	Orthodontist	10	30.0	10.5	-8.0	-1.350	0.19
	Layperson	10	38.0	15.5			
Lip	Orthodontist	10	29.0	8.8	-13.0	-2.600	0.02*
	Layperson	10	42.0	13.2			
Chin	Orthodontist	10	34.0	12.6	0.0	0.000	1.00
	Layperson	10	34.0	14.3			

Table 5: Comparison of mean VAS scores for different parameters between Pre & Post treatment time intervals among orthodontist using Student Paired t test

Parameters	Group	N	Mean	SD	Mean Diff	t	P-Value
Profile	Pre Rx	10	30.0	9.4	-33.0	-6.659	<0.001*
	Post Rx	10	63.0	14.2			
Nose	Pre Rx	10	33.0	8.2	-27.0	-5.449	<0.001*
	Post Rx	10	60.0	17.0			
Nasolabial	Pre Rx	10	34.0	9.7	-23.0	-8.835	<0.001*
	Post Rx	10	57.0	11.6			
Interlabial	Pre Rx	10	30.0	10.5	-31.0	-8.188	<0.001*
	Post Rx	10	61.0	12.0			
Lip	Pre Rx	10	29.0	8.8	-35.0	-6.708	<0.001*
	Post Rx	10	64.0	15.1			
Chin	Pre Rx	10	34.0	12.6	-33.0	-6.128	<0.001*
	Post Rx	10	67.0	13.4			

Table 6: Comparison of mean VAS scores for different parameters between Pre & Post treatment time intervals among Layperson using Student Paired t test

Parameters	Group	N	Mean	SD	Mean Diff	t	P-Value
Profile	Pre Rx	10	35.0	13.5	-24.0	-7.856	<0.001*
	Post Rx	10	59.0	13.7			
Nose	Pre Rx	10	47.0	18.9	-11.0	-2.905	0.02*
	Post Rx	10	58.0	15.5			
Nasolabial	Pre Rx	10	41.0	13.7	-21.0	-6.304	<0.001*
	Post Rx	10	62.0	6.3			
Interlabial	Pre Rx	10	38.0	15.5	-23.0	-6.273	<0.001*
	Post Rx	10	61.0	12.9			
Lip	Pre Rx	10	42.0	13.2	-19.0	-4.385	0.002*
	Post Rx	10	61.0	14.5			
Chin	Pre Rx	10	34.0	14.3	-31.0	-8.908	<0.001*
	Post Rx	10	65.0	15.1			

Conclusion

1. T values of Nasolabial angle by -6.909, Interlabial Gap by 9.204, Lower lip to E line by -10.776 and Chin prominence by -4.284 show that they were the most significant soft tissue changes
2. T values of U1/SN by -7.480, U1-L1 by -14.265, U1-AP by 11.457 and L1-AP by 5.656 show that they were the most significant hard tissue changes
3. Mean difference in of assessment of nose and lips is -14 and -13 respectively which suggests orthodontists judge better
4. Post treatment VAS scores were all positive suggesting both panels saw and perceived an improvement in profile
5. The VAS scores of both orthodontist and lay persons were all strongly affected but the lay persons panel VAS scores for nose and lip were weakly affected i.e. p values of 0.02* & 0.002*

We conclude that the orthodontic treatment definitely improves the aesthetics especially of nose and lip profile which could be more appreciated by orthodontists.

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