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The relationship between pre and post treatment soft tissue profile and American Board of Orthodontics objective grading system

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Abstract

Introduction: : The American Board of Orthodontics Objective Grading System (ABO OGS) is an index used to determine the improvement achieved by orthodontic treatment in cases submitted for Phase III of board-certification exam. This index can also be used by clinicians for self-evaluation of the finesse achieved in their cases. This study aims to determine the correlation between profile improvement and ABO OGS score.

Material and Methods: Total of 30 cases with ABO Discrepancy Index 16-24 were included in the study. The ABO OGS score was determined for these cases. Pre- and post-treatment Cephalograms were traced and the tracings were scanned and filled to produce silhouettes using Adobe Photoshop 7.0. An album was made with pretreatment silhouettes on the left side and post treatment on the right side. The improvement achieved in profile for each case was evaluated by 13 orthodontists and 31 orthodontic patients on a visual analogue scale (VAS). Mann Whitney U test was used to compare the scoring by orthodontist and orthodontic patients, and Spearman correlation test assessed the relationship between ABO OGS and VAS score.

Results: In 17 cases no significant difference existed between orthodontist and orthodontic patients, whereas in 13 cases the difference between the scorers was significant ($p \leq 0.05$). ABO OGS and VAS score were significantly correlated in only one case (r_s =-0.758; p=0.029) for scoring by orthodontist and in three cases for scoring by orthodontic patients (r_s = -0.802, -0.902, 0.776 and p=0.017, 0.002, 0.024 respectively).

Conclusions: Significant correlation was not found between ABO OGS score and improvement in soft tissue profile, therefore this study recommends revision of ABO OGS criterion for inclusion of soft tissue parameters to allow a more realistic evaluation of the success of orthodontic treatment.

Keywords: Orthodontics; treatment outcome; visual analogue scale

Introduction

A large number of patients seek orthodontic treatment for aesthetic concerns, rather than functional needs.[1] It is important to understand the patient's expectations from treatment as it affects motivation and compliance, and also leads to increased post-treatment patient satisfaction.[2] A successful orthodontic treatment should therefore aim at both improvements in function and aesthetics. However, aesthetic standards are highly subjective and vary amongst cultures and ethnicities.[3] Moreover, multiple factors associated with facial attractiveness such as youth, averageness, weight, color, symmetry, masculinity, femininity and voice further complicate our understanding of the subject.[4] Silhouettes eliminate most of these variables, and hence change in profile brought about by orthodontic treatment can be evaluated less subjectively.[5]

The American Board of Orthodontics Objective Grading System (ABO OGS) is an index used to determine the improvement achieved by orthodontic treatment in cases submitted for Phase III of board-certification

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exam. This index can also be used by clinicians for self-evaluation of the finesse achieved in their cases.[6] The ABO OGS evaluates eight occlusal features from study models and panoramic radiograph. These include (1) teeth alignment, (2) marginal ridge height, (3) buccolingual inclination, (4) occlusal relationship, (5) occlusal contact, (6) overjet, (7) teeth interproximal contact, and (8) root angulation. The aforementioned features are measured and points are deducted for each feature based on the deviation of a particular tooth from the criteria established by ABO (Table I). The cumulative score of all features determines if a case is complete or incomplete in ABO terminology, and whether a candidate passes or fails the clinical case report component of the exam, respectively. A case which loses 20 or less points is termed complete, whereas a loss of 30 or more points make a case incomplete. A case with an in between score is reevaluated and is passed on the prerogative of the Board. This index is valid and reliable, but it does not include analysis of soft tissue profile and smile aesthetics.[6] In a previous study that investigated the correlation of smile aesthetics with ABO objective grading system,[7] it was concluded that the Pearson correlation of eight components of ABO OGS, and the overall score are poorly correlated with the parameters of smile aesthetics (r values ranging from -0.11 to 0.14). These results indicate that beautifully articulated casts with parallel roots do not mean attractive smiles. To the best of our knowledge, no study has investigated the correlation between improvement in soft tissue profile and ABO OGS.

This study aims to determine the correlation between ABO OGS and improvement in soft tissue profile using silhouettes. These data will be helpful in determining whether the criteria established by ABO for post-treatment case evaluation translate into aesthetically pleasing profiles, or there is a need to expand the criteria to include soft tissue factors for a more comprehensive evaluation for the success of orthodontic treatment. Additionally, data from this study will increase our understanding of the patient's perception of improvement in soft tissue profile as correlated with improvement in occlusal features.

Table 1: The scoring criteria of American Board of Orthodontics Objective Grading System

Component	Deduction	
Alignment		0
<0.5mm	1	2
0.5-1mm		
1mm		
Marginal ridge height		0
<0.5mm	1	2
0.5-1mm		
1mm		
Buccolingual inclination		0
<1mm	1	2
1-2mm		
>2mm		
Occlusal contacts		0
0mm	1	2
<1mm		
>1mm		
Occlusal relationships		0
<1mm	1	2
1-2mm		
>2mm		
Overjet		0
0mm	1	2
<1mm		
>1mm		
Interproximal contacts		0
<0.5mm	1	2
0.5-1mm		
1mm		
Root angulation		0
Roots are parallel	1	2
Roots are not parallel		
Contacting adjacent teeth		

Material and Methods

The approval for the study was obtained from the Ethics Review Committee. It was a cross-sectional retrospective study for which the data collection was done from May to August 2018, at the Department of Orthodontics, Margalla Institute of Health Sciences, Pakistan.

The inclusion criteria were patients of both genders between the ages 12-20 years at the start of orthodontic treatment. Patients who had left the treatment incomplete, or those with malformed teeth, systemic diseases, craniofacial syndromes, surgical treatment plan or incomplete records were not included in the study. The pretreatment records were searched to select cases which fulfilled the inclusion criteria and had the ABO Discrepancy Index (DI) score of 16-24, which depicts moderate severity according to the ABO criteria.[8] The ABO (DI) quantifies the severity ofmalocclusion by scoring overjet, overbite, molar relationship, anterior open bite, lateral open bite, buccal crossbite, crowding, cephalometric values and others. The post treatment records of these selected cases were evaluated according to ABO OGS using ABO measuring gauge (Figure 1) according to the ABO guidelines.[9] Total of 30 cases which had ABO OGS score of less than 20 were finally selected.

The soft tissue profile of pre and post treatment lateral Cephalograms of each case included in the study were traced on an acetate sheet 21x 27 cm of dimension, mounted on the cephalogram by clear tape.

These tracings were done in a dark room with 0.5 mm lead pencil. The outlines were scanned into computer and filled using Adobe Photoshop 7.0 software to produce silhouettes. The silhouettes were transferred to Microsoft Word version 2013. The silhouettes for each patient were placed on the same sheet such that pretreatment was on the left side and post treatment was on the right side (Figure 2). The silhouettes were then printed and bound together in an album. The improvement in profile achieved in each case was scored on a Visual Analogue Scale (VAS) diagram by 46 evaluators. These included 15 orthodontists and 31 patients undergoing orthodontic treatment. The patients included in the study to evaluate profile improvement were 18-25 years old, both males and females and had been undergoing orthodontic treatment for at least six months. The VAS was a 100-mm line, where zero on the left indicated that the silhouettes were identical (no improvement) and 100 on the right indicated maximum improvement achieved in profile. The orthodontists included in the study had a post graduate qualification in orthodontics and at least five years of clinical experience. The patients who were asked to score were at least 18 years of age and had been

Figure 1: The American Board of Orthodontics Objective Grading System

Scoring Gauge.

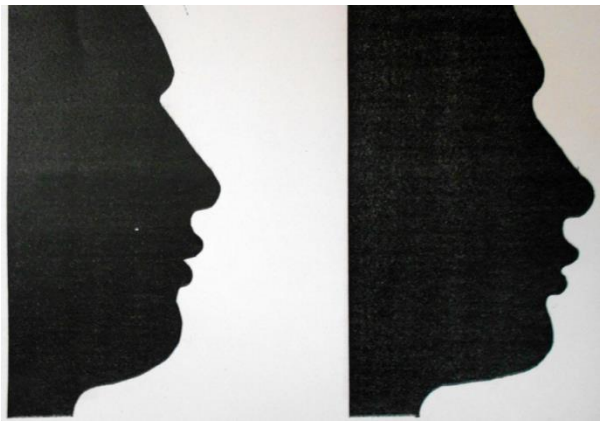

Figure 2: Pre and post treatment silhouette.

undergoing orthodontic treatment for at least six months. Five introductory silhouettes were shown to familiarize the evaluators with the rating procedure. Each evaluator was provided with the album, a questionnaire with 30 VAS diagrams and instructions to fill the questionnaire. The evaluators were asked not to spend more than 30 seconds to evaluate the improvement in each profile.

All statistical tests were performed using statistical software IBM SPSS Statistics SPSS version 24.0 (IBM Corp., Armonk, NY, USA). Confidence interval was set at 95% and p value ≤0.05 was considered significant for all tests. According to the results of Shapiro-Wilk test the data was not normally distributed, hence non-parametric tests were applied for statistical analysis. Descriptive statistics, median, 25th percentile and 75th percentile was calculated. Independent Sample Mann Whitney U test was applied to examine the difference in scoring by orthodontist and layperson. The relationship between occlusal outcome and perceived improvement in profile was evaluated by spearman correlation.

Results

Standard descriptive statistics were calculated for the score given to profile improvement by orthodontist and orthodontic patients. For each case the median score was calculated for orthodontist and orthodontic patient (Table II). Independent sample Mann Whitney U test was conducted to examine the difference in scoring by orthodontists and orthodontic patients. In 17 cases it was seen that no difference exists between scorers, whereas in remaining 13 significant difference (p≤0.05) was present between scoring by the two scorers. Therefore, Spearman correlation coefficient for each case was determined separately for orthodontists and orthodontic patients. The results are summarized in Table III.

Table II: Median Visual Analogue Scale scores by Orthodontists and Orthodontic Patients.

Case	Median VAS Scores		
	Orthodontist	Orthodontic Patients	P value
1	19.5	29.0	0.413
2	29.5	21.0	0.972
3	20.0	27.5	0.822
4	22.5	22.5	0.849
5	16.0	25.0	0.059
6	18.0	28.0	0.543
7	10.0	25.0	0.061
8	12.0	25.5	0.011*
9	13.5	27.5	0.043*
10	13.0	28.5	0.181
11	16.5	27.5	0.044*
12	21.5	21.5	0.675
13	14.5	23.0	0.188
14	15.5	32.0	0.001*
15	15.5	25.5	0.100
16	16.0	26.0	0.008*
17	15.5	23.5	0.039*
18	10.5	26.0	0.009*
19	14.0	22.5	0.020*
20	14.5	30.5	0.007*
21	16.5	30.5	0.074
22	14.0	30.0	0.063
23	16.5	28.0	0.259
24	8.5	27.0	0.002*
25	14.5	31.5	0.008*
26	28.5	28.5	0.526
27	18.5	25.5	0.079
28	10.5	24.5	0.009*
29	12.5	29.5	0.000*
30	22.0	22.0	0.062

Table III: Correlation between American Board of Orthodontics Objective Grading System score and Visual Analogue Scale score for profile improvement.

*p≤0.05 is significant

Case	Correlation of VAS score with ABO OGS score by Orthodontist		Correlation of VAS score with ABO OGS score by Orthodontic Patient	
	rs	p	rs	p
1	.386	345	-.114	.788
2	.145	731	.677	.065
3	.548	160	.325	.432
4	-.417	304	.038	.929
5	-.393	336	.047	.912
6	-.133	754	.109	.797
7	-.128	763	-.802	.017*
8	.061	885	-.574	.137
9	.100	814	-.605	.112
10	-.758	029*	-.902	.002*
11	.289	487	-.104	.806
12	.103	809	.339	.412
13	-.692	057	.038	.928
14	.390	339	.495	.212
15	.247	555	-.624	.098
16	-.195	643	.300	.470
17	.307	460	.856	.007
18	.098	817	.412	.310
19	.265	526	-.618	.102
20	-.583	129	-.203	.630
21	-.050	906	.776	.024*
22	-.457	.255	.300	.470
23	-.606	.111	-.231	.581
24	.049	.908	-.536	.171
25	.703	.052	-.509	.197
26	.463	.248	.012	.977
27	.605	.112	-.432	.285
28	-.012	.977	-.135	.750
29	.138	.744	-.228	.587
30	-.391	.338	-.082	.846

Since a lower score on ABO OGS signifies a case finished to perfection and a higher score was given in this study to greater improvement achieved in profile; a correlation coefficient of -1 was ideal. Whereas a correlation coefficient of +1 would signify no correlation between VAS and ABO OGS. The results show that there is a weak correlation between the ABO OGS score and the improvement in soft tissue profile which is not statistically significant.

Discussion

This study aimed to find the correlation between ABO OGS scoring and improvement in soft tissue profile evaluated on silhouettes traced using Lateral Cephalograms. The silhouettes from Pakistani population were included, and the evaluators were also Pakistani to eliminate the bias associated with preference of facial features between different ethnicities. To eliminate inclusion bias all the cases included in this study had similar severity of malocclusion at the beginning of treatment (ABO DI 16-24). Also, the evaluators were asked not to take more than 30 seconds for each profile evaluation, since previous studies have shown that the perception changes with increased time of observation.[10]

The orthodontic patients were included for profile evaluation in this study, because orthodontic patients are more aware and critical of profile changes as compared to layperson.[11] The orthodontic patients were acquainted with the use of silhouettes to evaluate profile changes without influencing their preference for attractiveness of any particular profile. Mann Whitney U test applied in this study showed significant difference in scoring between orthodontists and orthodontic patients for 13 of the total evaluated cases, and this is in accordance with a study by Mahmoudzadeh et al.[11] In their study, the orthodontic patients preferred a convex profile as compared to orthodontists' preference of straight profile. The results of the study by Pace et al[12] are also

in concordance with this observation. They also observed that patients are less critical of changes in sagittal jaw relationships as compared to orthodontists. Similar observations were made in the current study, where the patients tended to give higher score to profiles as compared to orthodontists. This difference in scoring can be attributed to the use of silhouettes for profile evaluation. In a study[13] which included African American orthodontic patients for evaluation of profile esthetics it was seen that esthetic attractiveness of African American faces was rated differently in photographs and silhouettes, by both orthodontists and orthodontic patients. It was seen that the use of silhouettes influenced researchers to select profiles that are flatter than the established esthetic norms, as the most esthetically pleasing profile.

The orthodontic treatment mainly affects lower third of the face by altering maxillary and mandibular dentoalveolar processes and position of the jaws, but the lower face alone does not depict the attractiveness of entire facial profile.[14] Hence it's important to assess entire facial profile for evaluation of attractiveness and thus we included whole face for profile evaluation.

The VAS used in this study allows ratings to be made with greater sensitivity than if semantic phrases are used, but each rater's judgment is subjective and influenced by rater's own body image and self-esteem.[15] A possible solution could be to use cephalometric norms to evaluate changes in profile. In a study by Marchiori et al[16] H-line and H angle were found to correlate positively with improvement in profile. Huang et al[17] evaluated the concordance between VAS score and cephalometric norms for improvement achieved in profile of class II malocclusion cases, they found that lip position and chin morphology were critical factors in achieving facial aesthetics. In their study[17] upper and lower lip to E-line, Pg-NB distance, mentolabial angle and depth of mentolabial sulcus were identified as significant factors in facial esthetic evaluation. In another study by Akaskali et al[18] which used photogrammetric method for evaluation of soft tissue profile using angular and linear measurements, ANB and nasal tip angle (N-Pn-Cm) were found to change significantly post-treatment. However, if cephalometric or photogrammetric norms are used for profile evaluation the difference in ethnicities should not be overlooked.[19]

The results of this study indicate that there is no statistically significant correlation between the improvement in soft tissue profile and ABO OGS score. Only for case 7, 10 and 21 significant correlation was seen between improvement in soft tissue profile and ABO OGS score. Although no published study has investigated the correlation between ABO OGS score and improvement in facial profile, studies have investigated the relationship between facial aesthetics and occlusal features. In a systematic review[20], it was seen that incisor retraction following extraction was associated with upper and lower lip retraction and increased nasolabial angle and soft tissue profile convexity.

A limitation of this study was that only records of the patients treated with camouflage were included, whereas in patients with severe skeletal discrepancy orthognathic surgery can provide the most predictable and aesthetic outcome.[21] Another limitation was that gender dimorphism was not considered i.e. the participants did not know if silhouettes were of males or females and also the difference in scoring by male and female participants was not accounted for in this study. Whereas, previous studies have concluded that profile evaluation varies between genders.[22]

The findings of this study imply the need of including soft tissue parameters in the evaluation of successfully treated cases. Future studies can be carried out to find correlation between improvement in soft tissue cephalometric norms and the ABO

OGS score on larger sample size of varied ethnicities.

Conclusions

This study did not find any correlation between ABO OGS score and soft tissue profile, hence correction of occlusal features cannot be used as predictor of improvement of soft tissue profile. It is suggested that ABO OGS criterion is revised for inclusion of soft tissue parameters for a more realistic evaluation of success of orthodontic treatment.

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