ASSESSMENT OF TREATMENT OUTCOMES OF THE GRADUATE CLINICAL PROGRAM IN SUEZ CANAL UNIVERSITY USING THE AMERICAN BOARD OF ORTHODONTICS OBJECTIVE GRADING SYSTEM: AN IN-VITRO STUDY

Hatem Nabil El Husseiny Elsayed[1], Hanady Mohamed Samih[2], Mohamed Adel Nadim[3]

• E-mail address:
  hatemnabil.mds@gmail.com

1. Postgraduate student at Orthodontic department, Faculty of Dentistry, Suez Canal University

2. Assistant Professor of orthodontics, Faculty of Dentistry, Suez Canal University.

3. Professor of Orthodontics, Faculty of Dentistry, Suez Canal University.

ABSTRACT

Introduction: The American Board of Orthodontics Objective Grading System (ABO-OGS) has established its validity, reliability and is a widely accepted objective index. A number of studies uses the Objective Grading System (OGS) to assess and compare the orthodontic treatment outcomes of universities and private practices. Also, to assess the efficiency of finishing protocols. **Aim**: The aim of the study was to use the ABO-OGS to assess the treatment outcomes of the orthodontic clinic program of the Suez Canal University over a period of five years (2017-2022). **Materials and Methods**: This retrospective observational study; with a total number of 122 unidentified post treatment casts and panoramic radiographic records that met the inclusion criteria was collected from the post graduate clinics of the Orthodontic Department, Faculty of Dentistry at Suez Canal University. **Results**: Patients with ABO-OGS pass score was (11.5%), borderline cases percentage was (21.3%), which represented almost (33 %) of the studied sample. While almost (67 %) of the total sample had a fail ABO-OGS score. **Conclusion**: There is increase in percentage of failed cases within the collected sample. This finding necessitate that the postgraduate clinicians should get orientation and calibration to both the ABO-OGS & The American Board of Orthodontics Discrepancy Index (ABO-DI), as a routine self-assessment method for better treatment outcomes.

INTRODUCTION

The continuous assessment of orthodontic treatment outcomes provides the orthodontists, general practitioners, post-graduate university residents and faculties an understanding of the treatment outcomes in order to implement needed changes and raise the quality of treatment over time [1].

Historically, orthodontic assessment of treatment outcomes relied on clinical expertise and subjective opinions. The lack of a reliable, valid and a standardized assessment of orthodontic treatment made it a challenge to assess and compare results. Over the years, the rise of evidence-based orthodontics emphasized the quantitative objective measures [1] "Evidence-based decision-making has become a hallmark of 21st century healthcare, and this trend has placed a premium on quantitative measures of treatment outcome". However, a symbiotic relationship between "evidence-based" and "experience-based" exists

which is mutually beneficial for the patients and clinicians [2].

Various objective indices have been used to assess the orthodontic treatment outcome. However, some of the most commonly used are the occlusal index [3], the Peer Assessment Rating [4,] and the American Board of Orthodontics (ABO) Objective Grading System (OGS) [5].

The ABO-OGS has established its validity, reliability and is a widely accepted objective index. A number of studies uses the OGS to assess and compare the orthodontic treatment outcomes of universities and private practices. Also, to assess the efficiency of finishing protocols. Since there are no previous studies assessing the overall orthodontic treatment quality over time in the Suez Canal university, this study was carried out.

MATERIALS AND METHODS

Study design & settings:

In this retrospective observational study; the post treatment casts and panoramic radiographs were collected from the post graduate clinics of the Orthodontic Department, Faculty of Dentistry at Suez Canal University.

This research project was approved from the ethical committee to be conducted with an ethical code number approval (333/2021) at (27/4/2021); as there was no intervention or interaction with human subjects. In addition; the post treatment Cases & radiographed individuals' names were unidentified (except for patient's gender).

All post treatment casts were collected by taking an immediate impression after case debonding then poured by the assigned technician in the Orthodontic Department Laboratory, Faculty of Dentistry at Suez Canal University.

Sample size Calculation

The sample size calculation was performed using G*Power version 3.1.9.4 The entries were extracted from the article published by Neoh et al [6] correlation coefficient value (r) of 0.25, two-sided type I error (α) of 0.05, and type II error (β) of 0.2 (80% power). This resulted in a total of 120 samples of post treatment records (casts and panoramic radiographic records) that met the inclusion criteria. It was collected of patients treated with fixed appliances in the orthodontic clinic program of Suez Canal University.

A total number of 122 unidentified (except for patient's gender) post treatment casts and panoramic radiographic records that met the inclusion criteria was collected.

Inclusion criteria

Post treatment records (Post treatment casts and panoramas) of patients treated with fixed appliances in the orthodontic clinic program of Suez Canal University were collected. The recruited cases were randomly numbered as they were collected from the unidentified respective treating orthodontist. Also, the post treatment records were collected only if both records are available and without any damage.

Exclusion Criteria:

The post treatment records were of patients who had craniofacial anomalies, such as clefts or craniofacial syndromes were excluded. Also, pre-orthognathic treatment records were excluded until the availability of the post-surgical treatment records. Lack of complete post treatment records (either Study casts or panoramic radiographs) excluded these records.

The ABO measurements:

The obtained unidentified post treatment records were assessed according to the ABO's OGS guidelines (Figure 1). Scores were considered to be passing if it was equal to 20 points or less, and were considered to be failed if it was equal to 30 points or more, according to the clinical examination of the American Board of Orthodontics. A score between 20 and 30 was considered borderline for passing, pending the second-phase evaluation [5]. The ABO's measuring gauge was used to calculate the (8) linear measurements (alignment, marginal ridges, occlusal relationship, root parallelism, buccolingual inclination, overjet, occlusal contacts and interproximal contacts) and given scores.

A. Step 1: Clinical linear measurements (Post treatment casts):

1. **Alignment:**

a) *Maxillary anterior region:*

Alignment of the incisal edges and lingual incisal surfaces of the maxillary incisors and canines (Figure 2, a).

b) *Mandibular anterior region:*

Alignment the incisal edges and labial incisal surfaces of the mandibular incisors and canines (Figure 2, b).

c) *Maxillary posterior region:*

The central grooves (mesio-distal) should all be in alignment. (Figure 2, c).

d) *Mandibular posterior region:*

The mesio-buccal and disto-buccal cusps of the molars and premolars ought to be in the same mesiodistal alignment (Figure 2, d).

If all teeth were in alignment, or within 0.50 mm of proper alignment, no points are recorded.

2. **Marginal ridges:**

The marginal ridges in both arches of adjacent posterior teeth should be at the same level, or within 0.50 mm of the same level (Figure 2, e), (Figure 2, f).

3. **Buccolingual inclination:**

a) *Maxillary posterior teeth:*

The straight edge should contact the lingual cusps of the maxillary premolars and molars. The Buccal cusps should be within 1 mm of the surface of the straight edge (Figure 2, g).

b) *Mandibular posterior teeth:*

The straight edge should contact the Buccal cusps of the mandibular molars and premolars. The Lingual cusps should be within 1 mm of the surface of the straight edge (Figure 2, h).

4. **Occlusal contacts:**

The functional buccal cusps of mandibular premolars and molars and the functional lingual cusps of the maxillary premolars and molars ought to be contacting the occlusal surfaces of the opposite teeth.

5. **Occlusal relationships:**

a) *Angle Class I relationship:*

The maxillary canine cusp tip should align with (or within 1 mm of) the embrasure or contact between the mandibular canine and adjacent premolar. The buccal cusps of the maxillary premolars and molars should align with (or be within 1 mm of) the embrasures or contacts between the mandibular premolars and first molar.

b) *Angle Class II relationship:*

The buccal cusp of the maxillary first molar should align with the embrasure or interproximal contact between the mandibular second premolar and first molar. The buccal cusp of the maxillary second molar should align with the

embrasure or interproximal contact between the mandibular first and second molars.

c) *Angle Class III relationship:*

When mandibular premolars are extracted, the buccal cusp of the maxillary second premolar should align with the buccal groove of the mandibular first molar.

6. Overjet:

a) *Posterior overjet:*

The buccal cusps of the mandibular premolars and molars should contact the center of the occlusal surfaces of the maxillary molars and premolars.

b) *Anterior overjet:*

The mandibular incisors and canines should contact the lingual surfaces of the maxillary incisors and canines. If this relationship occurs, no points were counted.

7. Inter proximal contacts:

This valuation is made by observing the maxillary and mandibular dental casts from an occlusal viewpoint. The proximal surfaces of the teeth should be in contact with one another. If 0.50 mm or less interproximal space exists, then no points are recorded.

B. Step 2: Radiographic measurement:

1. Root parallelism (Panoramic radiographs):

The maxillary & mandibular roots should be parallel to one another and perpendicular to the occlusal plane. If this situation occurs, then no points were counted.

Reference – ABO Cast/Radiograph Evaluation

See Grading System for Casts-Radiographs for entire discussion

ALIGNMENT/ROTATIONS

| 0.5 – 1 mm | = | 1 | for each tooth |
| > 1 mm | = | 2 | for each tooth |

OCCLUSAL CONTACTS

0 mm	=	satisfactory	
≤ 1 mm	=	1	(for each posterior
> 1 mm	=	2	tooth out of contact)

** Do **not** score diminutive distolingual cusps of the maxillary 1st and 2nd molars, nor lingual cusps of the mandibular first premolars. **Maximum of 2 points per tooth.**

MARGINAL RIDGES

| 0.5 - 1 mm | = | 1 | (for each interproximal contact |
| > 1 mm | = | 2 | between posterior teeth) |

** Do **not** include the canine-premolar contact.
Do **not** include the distal of lower 1st premolar.

OCCLUSAL RELATIONSHIP

< 1 mm	=	satisfactory	
1 - 2 mm	=	1	(for each maxillary **tooth** from the
> 2 mm	=	2	the canines to the 2nd molars)

BUCCOLINGUAL INCLINATION

0 - 1 mm	=	satisfactory	
1.1 - 2 mm	=	1	(for each posterior tooth)
> 2 mm	=	2	

** Do **not** score the mandibular 1st premolars nor the distal cusps of the second molars.

INTERPROXIMAL CONTACTS

| 0.6 - 1 mm | = | 1 | (for each interproximal |
| > 1 mm | = | 2 | contact) |

OVERJET

Anterior teeth must be contacting.

0 mm	=	satisfactory	
≤ 1 mm	=	1	(for each maxillary
> 1 mm	=	2	tooth)

Transverse posterior teeth:
    Mandibular buccal cusps are measured to the central fossa of the maxillary teeth.

ROOT ANGULATION

Parallel	= 0
Not parallel	= 1
Root contacting	
adjacent root	= 2 (for each **occurrence**)

Do **not** score the maxillary and mandibular canines.

NOTE: Gauge Width is 0.5 mm;   Gauge Height is 1 mm
Third molars are not scored unless they substitute for the second molars.
No tooth is scored more than two points per individual parameter.

Fig. (1) Objective grading system reference sheet as provided on the ABO website.
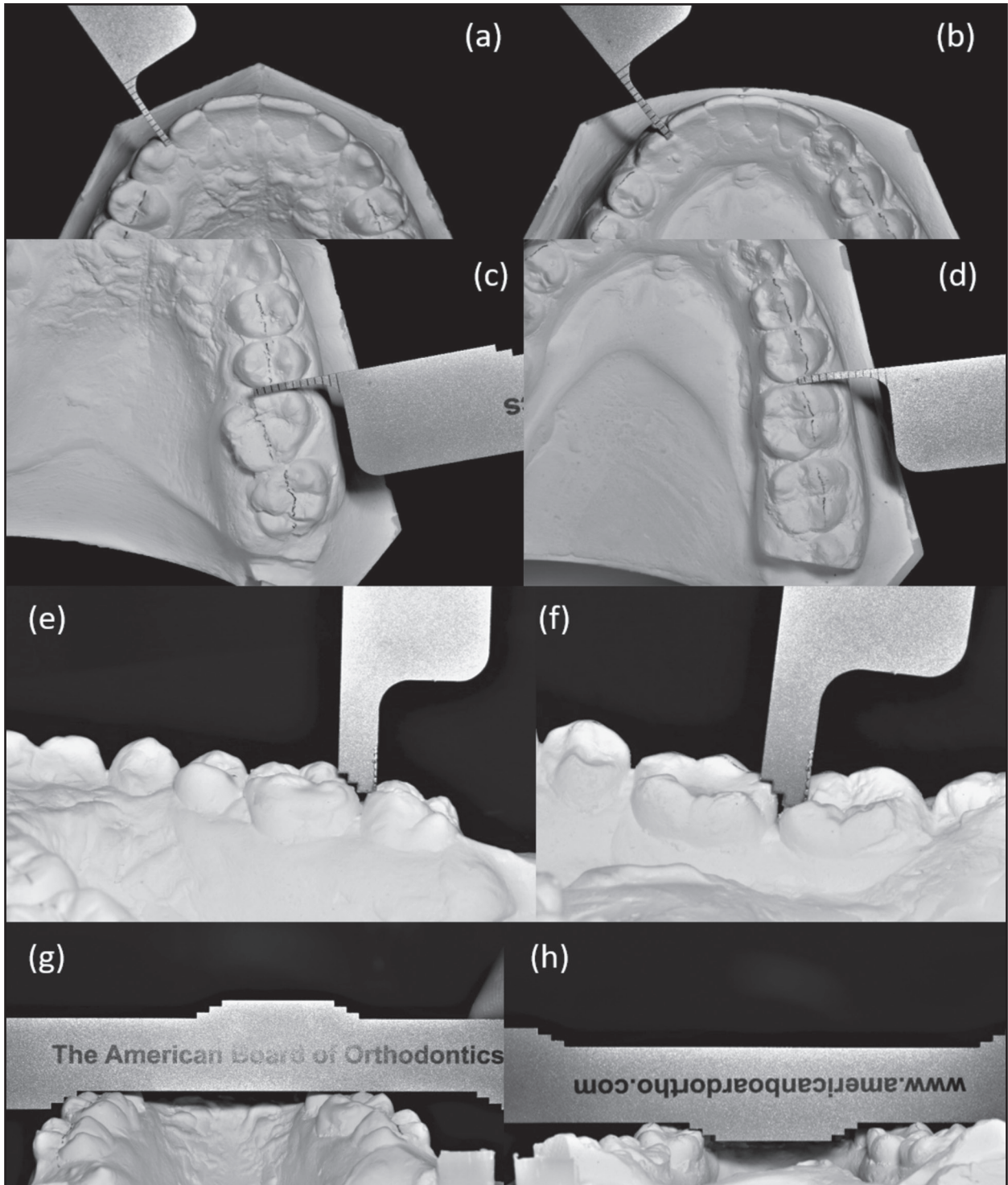
Fig. (2) Maxillary anterior alignment (a), Mandibular Anterior Alignment (b), Maxillary Posterior Alignment (c), Mandibular Posterior Alignment (d), Maxillary Marginal ridges (e), Mandibular marginal ridges (f), Maxillary buccolingual inclination measurement (g), Mandibular buccolingual inclination measurement (h).

RESULTS

1. Descriptive statistics of the objective grading system score for the total sample, pass, borderline and fail groups.

Table (1) show the ranges, means, SD, medians, and modes of the OGS score of the total sample, and the three main groups. The three groups were the pass group (CRE<20), borderline group (OGS 20-30), and fail group (OGS >30), respectively.

The mean of the total sample OGS score was 33.09 (SD 9.22), which falls into the failure category (OGS > 30). The Lowest score was 14 and the highest score was 53, with a median and mode score of 34 for each. The mean of the pass group OGS score was 16.42 (SD 1.91). The mean of the borderline group OGS score was 26.03 (SD 2.83). The mean of the fail group OGS score was 38.18 (SD 5.82).

Table (1) *Descriptive statistics of OGS score of the pass, borderline, fail groups, and the total sample.*

Group	Min	Max	Mean	S. D	Median	Mode
Pass group	14	19	16.42857	1.910066	16	14
Borderline group	20	30	26.03846	2.835218	27	27
Fail group	31	53	38.18293	5.824868	36.5	34
Total OGS Score	14	53	33.09836	9.227528	34	34

2. Descriptive statistics of the total cast-radiograph evaluation score along the observation period (2017-2022).

In the current study, there were 14 records with Pass score (11.5%), 26 records with borderline score (21.3%) and 82 records with fail score (67.2%). (Figure 3)
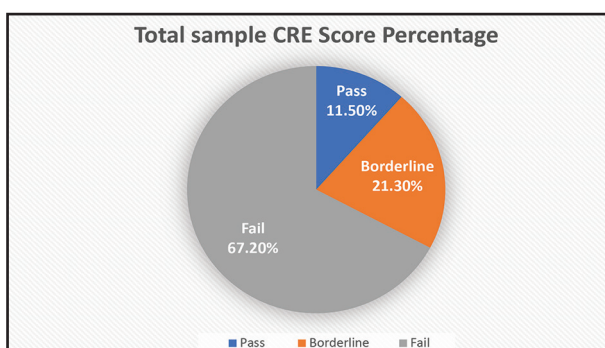

Fig. (3) Pie chart showing percentage of the Treatment outcome regarding the objective grading system total sample score.

Table (2) show that in the period between 2017-2018 there was a total of 25 records evaluated with 12% Pass, 32% borderline and 56% fail regarding total cast-radiograph evaluation score. Between 2018-2019 there was a total of 24 records evaluated with 12.5% Pass, 25% borderline and 62.5% fail regarding total cast-radiograph evaluation score. In the current study for 2019-2020 period, there was a total of 21 records evaluated with 0% Pass, 9.5% borderline and 90.4% fail regarding total cast-radiograph evaluation score, while for 2020-2021 period there was a total of 21 records evaluated with 4.76% Pass, 9.52% borderline and 85.7% fail. Finally, for 2021-2022 there was a total of 31 records assessed with 22.58% Pass, 25.8% borderline and 51.61% fail regarding total cast-radiograph evaluation score.

Table (2) *Descriptive statistics and percentage of the total cast-radiograph evaluation score within the observation period (2017-2022)*

Score	Years					Percentage
	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	
Pass	3 (12%) 0.0% RT 0.0% CT 0.0% GT	3 (12.5%) 14.3% RT 11.1% CT 1.6% GT	0 (0%) 0.0% RT 0.0% CT 0.0% GT	1 (4.7%) 21.4% RT 12.0% CT 2.5% GT	7 (22.5%) 64.3% RT 28.1% CT 7.4% GT	14 (11.5%)
Borderline	8 (32%) 23.1% RT 27.3% CT 4.9% GT	6 (25%) 15.4% RT 22.2% CT 3.3% GT	2 (9.5%) 11.5% RT 12.0% CT 2.5% GT	2 (9.5%) 7.7% RT 8.0% CT 1.6% GT	8 (25.8%) 42.3% RT 34.4% CT 9.0% GT	26 (21.3%)
Fail	14 (56%) 19.5% RT 72.7% CT 13.1% GT	15 (62.5%) 14.6% RT 66.7% CT 9.8% GT	19 (90.47%) 26.8% RT 88.0% CT 18.0% GT	18 (85.7) 24.4% RT 80.0% CT 16.4% GT	16 (51.6%) 14.6% RT 37.5% CT 9.8% GT	82 (67.2%)
Total	25 (20.49%)	24 (19.67%)	21 (17.21%)	21 (17.21%)	31 (25.4%)	122

DISCUSSION

The objective & quantitative assessment of orthodontics program or a private practice is valuable in understanding & implementing needed changes and improve the quality of treatment over time [7]. The ABO-OGS has established its reliability, validity and is a widely accepted objective index [8].

Since, no prior research has been done to assess the treatment outcome of the orthodontic post graduate clinical programs in Suez Canal University using the ABO-OGS. Therefore, the goal of this study was to use the ABO-OGS to assess the treatment outcomes of the orthodontic clinic program of the Suez Canal University over a period of five years (2017-2022) through determining the percentage of treated cases that would pass the ABO clinical examination using the Objective grading system.

Post treatment records of patients treated with fixed appliances were collected from the department of orthodontics, Suez Canal University. Post treatment records of patients were enrolled in this study according to the inclusion criteria over a period of 5 years (2017-2022).

Regarding, the sample size calculation, the suggested sample size was 120 post treatment patients records that could achieve 80% power to reject the null hypothesis, with a significance level of (alpha) 0.05.

In the current study, the mean of the total sample OGS score was 33.09 (SD 9.22), which falls into the failure category (OGS > 30). This result comes into agreement with the findings of studies done by other universities. A study was done to assess the treatment outcome at Indiana University (USA) for the years of (1998-2000), results showed a mean of 34.36 (SD 10.39)[9]. Another study was conducted comparing the treatment outcomes of Okayama University (Japan) & Indiana University (USA), with means of 33.6 (SD 13.6) & 32.8 (SD 10.3) respectively [10].

On the contrary, other studies presented lower means for the total OGS scores. Two consecutives follow up studies were done at Indiana University, after a first study done for the years of (1998 to 2000) at the same University [9].

A study was performed to assess the treatment outcomes for Indiana University (USA) for the period of (2001 to 2003), results showed a mean of 25.19 (SD 11.54) [7]. While another study examined the orthodontic classes of (2004-2006) to assess the factors that affect orthodontic treatment period. The results showed a mean of (23.34) [11]. This improvement could be due to the changes applied to the clinical protocol at Indiana University (USA), which included the routine collection of prefinished records, educating the residents about problem areas shown in previous studies, and more frequent practice evaluations.

CONCLUSION

From the obtained results it could be concluded that Patients with ABO-OGS pass score was (11.5%), borderline cases percentage was (21.3%), which represented almost (33 %) of the studied sample. While almost (67 %) of the total sample had a fail ABO-OGS score.

RECOMMENDATIONS

1. Orientation and calibration of the postgraduate clinicians to both the ABO-OGS as a routine self-assessment method for the treatment outcomes.

2. Inclusion of the discrepancy index (ABO-DI) together with the ABO-OGS as part of the clinical protocol of the postgraduate orthodontic program in order to measure the pre-treatment complexity, and its relationship to the post-treatment results.

3. For further studies, establishing a digital database for pre-treatment and post treatment records (Models, panoramas, lateral cephalometries and CBCT) would greatly help upcoming researchers.

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