Treatment outcomes after extraction and nonextraction treatment evaluated with the American Board of Orthodontics objective grading system

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Introduction: A controversy exists regarding better treatment outcomes when patients treated with extractions and without extractions are evaluated. The aims of this study were to use the American Board of Orthodontics objective grading system (ABO-OGS) to evaluate and compare treatment outcomes in extraction vs nonextraction Class I patients and to determine whether the treatment choice was a significant predictor of success according to the ABO examination. **Methods:** Discriminant analysis was applied to a sample of 542 patients, and a borderline sample of 55 patients was obtained. Of these patients, 25 were treated with extractions and 30 without extraction of the 4 first premolars. Treatment results were then assessed using the 8 variables of the ABO-OGS. **Results:** The total scores ranged from 11 to 41 (mean, 27.04; SD, 6.3) for the extraction group and from 16 to 44 (mean, 29.07; SD, 7.1) for the nonextraction group. The variable of buccolingual inclination had the highest scores in both groups (8.44 [SD, 3.3] for the extraction group; 8.90 [SD, 3.8] for the nonextraction group; mean difference, 0.46; 95% CI, −1.44, 2.37; $P = 0.63$). However, no statistically significant intergroup differences were found, either between the scores of the 8 ABO-OGS variables or between the total ABO-OGS scores. Regarding the success rates of the ABO examination, no significant difference was found between the 2 treatment groups (odds ratio, 2.55; 95% CI, 0.74, 0.85; $P = 0.14$). **Conclusions:** For a patient with a borderline Class I malocclusion, extraction and nonextraction treatment can achieve the same quality of results as assessed by the ABO-OGS. Additionally, in these Class I patients, the treatment modality (extraction or nonextraction) is not a significant predictor of passing the ABO examination. (Am J Orthod Dentofacial Orthop 2014;146:717-23)

In addressing a Class I malocclusion, there are 2 main treatment modalities: extraction and nonextraction. In clear-cut cases, the decision is easy to make; however, when the pendulum starts to swing between the 2 different treatments, the orthodontist must decide which one to implement.[1-4] Then it would be of paramount importance to know which modality is more likely to achieve better treatment results.

Comparing outcomes of inadequately matched extraction and nonextraction subjects would introduce bias to a research study, since the differences at the outcome would simply reflect preexisting differences at the onset of treatment. When conducting a retrospective project aiming at posttreatment comparisons of various techniques or treatment modalities, the discriminant analysis is the ideal statistical analysis; it ensures that all variables that might influence a clinician's treatment decision are considered.[5] When used in orthodontics, discriminant analysis can assign group membership, identify a borderline spectrum of patients who could belong to either group, and provide variables with unique discriminating power.[6-9] Borderline subjects have the same probability of being included in different treatment groups and are therefore ideal for various posttreatment comparisons.[10,11]

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Richmond et al[12] in 1992 introduced the peer assessment rating index, which focuses mainly on a patient's degree of improvement. Specifically, it evaluates the malocclusion improvement between the initial and final situations, but it does not measure with precision tooth positions and occlusal results. Later, an assessment of treatment need, complexity, improvement, and final outcome was appraised by the index of complexity, outcome, and need, which was introduced by Daniels and Richmond[13] in 2000. The main advantages of this index were its ability to provide more objective information and its simplicity, since no special equipment was required. The main drawback of this index was that esthetics constituted the most important part of the evaluation. The American Board of Orthodontics (ABO) recommended a more integral way of evaluating treatment outcomes: the ABO objective grading system (ABO-OGS).[14] The ABO-OGS index can evaluate completed orthodontic treatment using dental casts and radiographs. Furthermore, a high percentage of accordance can be achieved in both interexaminer and intraexaminer assessments. The ABO-OGS index is an evaluation method of the final occlusion with 8 criteria that contribute to ideal intercuspation and function. To make the measuring process more reliable, a measuring instrument was recommended. Ideal occlusion and alignment achieve a score of 0 points. For each parameter that deviates from ideal, 1 or 2 points are added. Cases are classified as successful or failed according to their ABO-OGS scores. A score of 20 points or fewer will usually pass the ABO examination, and a score of more than 30 points will usually fail. Cases scoring between 20 and 30 are subject to individual reassessment.[14-20] These advantages have led to the widespread use of the ABO-OGS in assessing treatment outcomes.[15-21] Our aims in this study were to identify, through discriminant analysis, a bias-free sample of borderline extraction and nonextraction Class I patients and to compare their treatment outcomes with the ABO-OGS. The investigated parameters were the occlusion and the root angulation criteria established by the ABO. Additionally, we investigated whether the treatment choice was a significant predictor of the success of the ABO examination.

MATERIAL AND METHODS

In this retrospective study, the parent sample consisted of the records of 542 patients gathered from 5 private orthodontic practices and from the University of Athens graduate orthodontic clinic in Greece. The inclusion criteria for the parent sample were white male or female patients with a Class I dental and skeletal malocclusion, a full complement of teeth excluding the third molars, no previous orthodontic treatment, no clefts or dentofacial deformities, and no orthognathic surgery treatment plans. Of the parent sample, 331 patients were female and 211 were male; 145 were treated with extraction of 4 first premolars, and 397 received nonextraction treatment. All patients were treated with preadjusted edgewise appliances in both arches and had a complete set of diagnostic records. The records used in the study were plaster dental casts, panoramic radiographs, and lateral cephalograms. All lateral cephalograms were taken in natural head position and were traced and analyzed using ViewBox (version 4.0.1.7; dHAL Software, Kifissia, Greece).

The parent sample was reduced to the borderline sample. Statistical analysis in this study was carried out using SPSS software (version 19.0; IBM, Armonk, NY) and included descriptive and inferential statistics. First, a stepwise discriminant analysis was performed in the parent sample to identify the borderline sample. The variables used in the discriminant analysis were 26 cephalometric measurements, 6 model measurements, and the demographic variables of age and sex (Table I). We attempted to consider all skeletal, dental, soft-tissue, and demographic traits that might have influenced the clinician's treatment decision.

The discriminant function resulted in 4 significant ($P < 0.000$) discriminating variables: in descending order of importance, mandibular crowding (−0.728), lower lip to E-plane (−0.407), maxillary crowding (0.347), and overjet (−0.219). The standardized canonical discriminant function coefficients allow us to compare variables measured on different scales. Coefficients with large absolute values correspond to variables with greater discriminating ability. The variable of mandibular crowding contributed the most to the extraction decision and was the 1 variable with unique discriminating power. The second discriminating variable of lower lip to E-plane showed the important role of facial esthetics on treatment planning. A summary of the stepwise discriminant analysis with the 4 discriminating variables is listed in Table II. Each variable entered the discriminant function at a high level of significance ($P < 0.001$). Additionally, Table II shows the progressive reduction achieved in the overall value of the Wilks lamda with the stepwise method. The process was finalized when the fourth variable (overjet) entered the function, since any additional variables were unable to lower the Wilks lamda value to improve the model. The value of the Wilks lamda indicated that the canonical discriminant function achieved a significant ($P < 0.001$) degree of discrimination between the 2 treatment group centroids (Table III).

Each patient concluded with a standardized discriminant score (Z score) according to which he or she was