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Efficiency of Class I and Class II malocclusion treatment with four premolar extractions

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ABSTRACT

Four premolar extractions is a successful protocol to treat Class I malocclusion, but it is a less efficient way when compared with other Class II treatment protocols. Objective: The objective of this study was to evaluate the influence of anteroposterior discrepancy on the success of four premolar extractions protocol. For that, treatment efficiencies of Class I and complete Class II malocclusions, treated with four premolar extractions were compared. Methods: A sample of 107 records from 75 Class I (mean age of 13.98 years - group 1) and 32 Class II (mean age of 13.19 years – group 2) malocclusion patients treated with four premolar extractions was selected. The initial and final occlusal status of each patient was evaluated on dental casts with the PAR index. The treatment time was calculated based on the clinical charts, and the treatment efficiency was obtained by the ratio between the percentage of PAR reduction and treatment time. The PAR index and its components, the treatment time and the treatment efficiency of the groups were statistically compared with t tests and Mann-Whitney U-test. Results: The Class II malocclusion patients had a greater final PAR index than Class I malocclusion patients, and similar duration (Class I - 28.95 months. and Class II - 28.10 months.) and treatment efficiency. Conclusion: The treatment of the complete Class II malocclusion with four premolar extractions presented worse occlusal results than Class I malocclusion owing to incomplete molar relationship correction.

Keywords: Treatment protocols. Efficiency. Tooth extraction.

INTRODUCTION

Class II and Class III malocclusions have in common a molar relationship discrepancy, which can or cannot require correction depending on the treatment protocol[8,13,26]. When treatment is planned with or without extraction of four premolars, a Class I molar relationships is expected at the end of treatment. However, if only two premolars are extracted in a single arch, the initial molar relationship discrepancy should be maintained, while the other occlusal characteristics are normalized[4,8,14,16,26].

Efficiency of Class II malocclusion correction has been compared between the different treatment protocols for this malocclusion[13,21,22,28]. The two premolar extractions protocol presented better occlusal results in a shorter treatment time when compared with non-extraction and four premolar extractions protocols, probably due to difficulties associated with molar relationship correction in these treatment approaches[13,14,18]. However, this speculation cannot be easily demonstrated because the comparisons were performed between different treatment protocols.

Thus, this study was designed to compare cases with and without requirement of molar relationship correction, but using the same treatment protocol. For that, treatment efficiency of Class I and complete Class II malocclusions, treated with four premolar extractions were compared.

MATERIAL AND METHODS

The sample size was calculated considering a value of 5% and 20% for α (type I error) and β (type II error). The value of the measurement variance σ2 (standard deviation) was based on a previous study[7]. Since weighted PAR score ranging of 2 has clinically significant impact on occlusal

relationship, it was the minimum difference to be detected between groups[29]. Thus, a minimum of 16 patients in each group was required. The sample was retrospectively selected from the files of the Orthodontic Department at Bauru School of Dentistry. According to the objectives of this study, the primary inclusion criteria was patient records presenting Class I and complete bilateral Class II division 1 malocclusions treated with four first premolar extractions and standard fixed edgewise appliances. Additionally, the patients should present all permanent teeth up to the first molars and no dental anomalies of number, size, and form. Patients had not been submitted to RME or orthodontic-surgical approach. Considering these criteria, 75 Class I (47 female, 28 male – group 1) and 32 Class II (14 female, 18 male – group 2) malocclusion patients were selected from all treated and documented patients. Group 1 presented an initial mean age of 13.98±2.08 years (range, 10.54–23.13 years) and group 2 had an initial mean age of 13.19±1.58 years (range, 10.48–18.58 years). Considering that patients had unequal distribution between the groups (1:2), the sample size was recalculated to compensate this specific disproportion. A total sample size with a minimum of 48 patients was required (N=16 and N=32), confirming that the number of selected patients was adequate.

Orthodontic mechanics included 0.022x0.028-inch fixed standard edgewise appliances, and extraction of four first premolars. Cases with severe initial anterior tooth crowding required initial canine retraction, followed by leveling and alignment with the usual wire sequence characterized by an initial 0.015-inch twist-flex or a 0.016-inch nitinol, followed by 0.016, 0.018, 0.020, and 0.019x0.025-inch stainless steel archwire (Unitek, Monrovia, California, USA). Deep bite was corrected with accentuated and reversed curve of Spee. The extraction spaces were closed with "en masse" retraction of the anterior teeth, with elastic chains on a rectangular archwire. Class II patients used extraoral appliance for anchorage reinforcement and anteroposterior relationship correction. When necessary, Class II elastics were also used to aid in Class II anteroposterior correction.

The patients' records were used to determine their initial age (I-Age), sex, date of treatment onset, date of treatment completion, and total treatment time (TT).The initial and final occlusal statuses were evaluated using the peer assessment rating (PAR) index[29], which was calculated on the pretreatment and posttreatment dental study models of each patient, according to the American weightings suggested by DeGuzman, et al.[6] (1995). Initial and final occlusal characteristics were ranked by scores for molar and premolar AP relationship, overjet, overbite, midline, and crowding to quantify the initial malocclusion severity (I-PAR), the occlusal treatment results (F-PAR), and the percentage of PAR reduction (PcPAR), which is a better estimate of occlusal improvement[11].

Since the PAR index analyzes a set of occlusal characteristics at the same time and does not discriminate the degree of participation of each in the total score, the posttreatment scores obtained for each PAR component were compared individually to determine the success rate achieved. Therefore, the PAR score at the end of treatment was separated into its several components to allow an individual evaluation. The treatment efficiency index (TEI) was evaluated by the relationship between PcPAR and TT in months, expressed as TEI=PcPAR/TT[13]. The TEI increased when a greater PcPAR and/or a shorter TT was observed.

Error study

Initial and final PAR scores were recalculated by the same examiner (AYN) in the pretreatment and posttreatment study models of 20 randomly selected patients after 30 days from the first measurement. The casual errors were estimated by Dahlberg's formula ($Se^2=\sum d^2/2n$), where S^2 is the error variance and d is the difference between 2 determinations of the same variable; the systematic errors were calculated with dependent t tests, at $P<0.05$.

Table 1- Compatibility of Class I and complete Class II malocclusion groups regarding sex and age

	Group 1		Group 2		
	Class I (n=75)		Class II (n=32)		
	n	%	n	%	p
Female	47	62.67	14	43.75	0.070§
Male	28	37.33	18	56.25	
Initial Age	13.98±2.07		13.19±1.57		0.056€

§ Chi-square test

€ t test

Statistical analyses

Compatibility of the groups regarding the proportion of sexes was evaluated with chi-square tests, while the I-Age similarity between the groups was evaluated with t test.

The PAR index variables (I-PAR; F-PAR; PcPAR) were compared between the groups using t tests.

The occlusal results obtained for each component of the PAR index were individually compared between the groups with the Mann-Whitney U-test. A nonparametric test was used because the values of each PAR component did not show normal distribution. The percentage of contribution from each PAR component to the total value of the F-PAR was also calculated.

The treatment time and treatment efficiency index were compared with t tests, and the influence of the variables Molar Relationship (MR); Sex (S); I-Age; I-PAR, F-PAR and PcPAR on treatment time was evaluated by multiple linear regression analysis.

RESULTS

The PAR evaluation did not present a significant systematic error, and the casual error was within acceptable level (PAR=1.5).The groups were similar regarding the proportion of sexes, initial age and treatment time (Table 1).

The initial severity (I-PAR) of Class I and Class II malocclusions were similar in the groups. The better occlusal results and success rate were achieved in group 1, that had a significantly smaller F-PAR and a greater PcPAR (Table 2).

Molar and premolar AP relationship was the only final PAR index component that showed statistically significant difference between the groups, and its greater score value represents a worse AP relationship obtained in group 2. Molar and premolar AP relationship contributed only with 23% of the total F-PAR value obtained in Group 1, while 43.95% of the total F-PAR value obtained in Group 2 was due to it (Table 3).

Treatment time (TT) and treatment efficiency index (TEI) were similar in the groups. The variables that comprised the regression analysis model showed no significant influence on treatment time, and they had a low predictive value to explain the duration of orthodontic treatment (Table 4).

Table 2 - Comparison of Class I and complete Class II malocclusion groups regarding PAR score

	Class I (n=75)		Class II (n=32)		
	Mean	**SD**	**Mean**	**SD**	**P**
I-PAR	23.64	5.45	26.18	7.53	0.052
F-PAR	2.40	3.08	5.12	5.69	0.001*
PcPAR	89.46	14.39	79.18	24.58	0.008*

* Statistically significant at P<0.05.
I-PAR=initial malocclusion severity
F-PAR=occlusal treatment results
PcPAR=percentage of PAR reduction

Table 3- Comparison of Class I and complete Class II malocclusion groups regarding F-PAR individual components, and proportion of each PAR component in F-PAR

	Class I (n=75)		Class II (n=32)			
	%	**Mean Rank**	**%**	**Mean Rank**	**Z**	**(U) p**
AP	23.33	50.05	43.95	63.32	-2.755	0.005*
Overjet	30.42	52.54	33.40	57.42	-1.174	0.240
Overbite	28.33	52.51	20.12	57.46	-1.006	0.314
Midline	3.33	54.42	0	53.00	0.928	0.353
Crowding	14.17	56.21	2.34	48.81	1.578	0.114

U Mann-Whitney U test
* Statistically significant at P<0.05.
F-PAR=occlusal treatment results

Table 4- Comparison of Class I and complete Class II malocclusion groups regarding treatment time (TT - in months) and treatment efficiency index (TEI), and multiple regression analysis with treatment time as the dependent variable

	Class I (n=75)		Class II (n=32)		
	Mean	**SD**	**Mean**	**SD**	**p**
TT	28.95	10.39	28.10	7.02	0.673€
TEI	3.44	1.25	2.98	1.25	0.085€
Multiple regression analysis					
	βcoefficients	SD	p	R2	
AP	-1.41	2.19	0.522	0.044¥	
Sex	-0.56	1.90	0.768		
Initial Age	-0.14	0.49	0.774		
I-PAR	0.17	0.21	0.410		
F-PAR	0.70	0.91	0.441		
PcPAR	0.17	0.20	0.392		

€ t test
¥ Multiple regression analysis
I-PAR=initial malocclusion severity
F-PAR=occlusal treatment results
PcPAR=percentage of PAR reduction

DISCUSSION

Molar relationship correction is an essential objective of Class II malocclusion treatment with four premolar extractions, which can be influenced by some factors. Patient sex and age is associated with the craniofacial growth potential, and patient compliance degree can also change according to these variables[9,20,30]. Considering that patient growth and compliance influence Class II malocclusion correction, compatibility of the groups regarding sexes proportion and initial age allowed an unbiased molar relationship correction evaluation (Table 1). Although not significantly, the slightly smaller initial mean age and the greater male patient proportion of group 2 benefited Class II malocclusion treatment since, at this mean age range, Class II treatment at a younger age is more favorable because there will be greater growth changes that can be redirected with treatment[10,23]. Males are benefited in Class II treatment at this mean age because their growth spurt occurs later than in females, and occurs a little later than the initial mean age reported. Therefore, treatment was conducted in a large number of males during their peak growth spurt[10,23]. However, this was not enough to ensure a similar occlusal result to group 1.

The similar initial malocclusion severity observed in the groups could be considered an unexpected result because Class II malocclusion has an anteroposterior discrepancy that is not present in Class I (Table 2). However, the overjet was the only different malocclusion trait between the groups. Therefore, it was not enough to produce a significant intergroup discrepancy regarding the total PAR value.

The worst occlusal result and PcPAR correction of Class II malocclusion treatment does not seem to be associated with the extraction protocol because both were treated with four-premolar extractions (Table 2). Incisor crowding or labial tipping is easily solved during anterior retraction and they would unlikely affect the PcPAR correction. However, Class II treatment with or without four premolar extractions always require molar relationship correction, and a deficient anteroposterior correction can affect the PcPAR correction[4,12-14,17,19]. Thus, if initially there is a Class I relationship, as in group 1, four premolar extractions will not affect the treatment results, but if there is a complete initial Class II molar relationship, as in group 2, its incomplete correction can compromise the treatment results.

This inherent difficulty of molar relationship correction significantly influenced the treatment results and the PcPAR correction of the Class II group. The AP relationship was the only F-PAR component that was significantly worse for the Class II group at the end of treatment (Table 3). The AP relationship of Class I and complete Class II malocclusions are equally scored with the PAR index because Class II molar relationship is considered an adequate final occlusion when only maxillary premolars are extracted, with successfully corrected canine relationship, overjet and overbite[26]. Thus, the initial AP relationship

score was similar between the groups, but at the end of orthodontic treatment the AP relationship was deficient in group 2 due to the difficulty to treat a complete Class II to a Class I relationship[13,14]. In fact, the final AP relationship score represented almost half of the F-PAR in group 2, while group 1 showed an F-PAR value with a more equilibrated score distribution among the PAR components, without a predominant factor determining treatment limitations (Table 3).

Although the PcPAR reduction was smaller in the Class II than in the Class I group due to the difficulty to correct molar relationship, treatment time was similar in the groups, probably because orthodontic treatment was finished before total Class II correction (Table 4). This similar treatment time contributed to a similar treatment efficiency index (TEI) in the groups in spite of the smaller PcPAR reduction of the Class II group. Perhaps, if group 2 patients were treated up to a better molar relationship, its treatment time would be longer than the Class I group. However, when the occlusal results are essentially dependent on patient compliance, a longer treatment time does not always mean an actual treatment progress towards planned objectives if the patient is not engaged or concerned in obtaining the best results that orthodontic treatment can provide. Consequently, and contrary to common sense, longer treatments are frequently associated with less satisfactory results, and additional active treatment could not improve the results of noncompliant patients[27]. In these cases, two options should be considered by the professional in the patient's best interest: 1- orthodontic treatment of noncompliant patients should not be continued in the hope of attaining a better result[27]; 2- whenever possible, a compliance free appliance could be attempted[24], although minimal patient cooperation and caution with hygiene, appointments and appliance breakage will always be necessary to adequately conduct orthodontic treatment[27].

The regression analysis showed that none of the independent variables explained treatment time satisfactorily (Table 4). This absence of correlation between treatment time and success rate corroborates the thought that treatment protocols with high requirement of patient compliance have low success predictability regardless of the treatment time spent[5,13,14,24,27]. Thus, molar relationship correction did not contribute significantly to explain treatment duration because some patients had, simultaneously, longer treatment time and greater F-PAR score due to unsatisfactory correction of molar relationship. AP correction was not improved when treatment time was extended in the effort of obtaining a better treatment result. Briefly, if patient compliance is not obtained, treatment time will have no influence on AP correction when Class II mechanics is fully patient-dependent. Other variables had yet smaller predictive values to determine treatment time because, theoretically, obtaining an ideal occlusion is usually taken as a strong clinical parameter to determine appliance removal. But, if an ideal occlusion cannot be obtained, treatment ending will become a subjective decision and treatment time can vary according to unconventional parameters.

Clinical implications

Some occlusal objectives of orthodontic treatment are inherent to the protocol choice. Thus, if four premolar extractions protocol is chosen, a Class I molar relationship should be established at the end of treatment regardless of the initial anteroposterior relationship[4,25,26]. Because of the demonstrated difficulty to correct the AP relationship, a four premolar extractions protocol should be used with caution when the initial molar relationship is severely displaced from Class I and patient growth potential is reduced or absent. In these cases, premolar extractions in a single arch can be the best choice concerning occlusion. This extraction protocol does not require molar relationship changes to correct canine relationship and overjet, increasing the predictability of the occlusal results due to the smaller need of patient compliance with anchorage reinforcement and intermaxillary elastics[3,4,14,15].

In Class II malocclusions, even when the orthodontist is convinced that patient compliance will be good and that the growth potential could help to achieve a Class I molar relationship, the four premolar extractions protocol should be used with caution, since it produces greater incisor retraction than two maxillary premolar extractions[1,4,14], and the patient profile may not be benefited with these soft tissue changes. Thus, orthodontists should definitely include the two premolar extractions protocol in their treatment options. However, it is necessary to have in mind that this protocol requires specific orthodontic mechanic guidance on how to correctly position the teeth when a final Class II molar relationship is intended, allowing the establishment of an excellent static and functional occlusion with smaller incisor retraction, soft tissue changes, patient compliance needs and unsuccessful results[2-4,14-16,26,31].

CONCLUSIONS

Class I malocclusions treated with four premolar extractions had better occlusal treatment results

and greater success rate than complete Class II malocclusions similarly treated;

Molar relationship correction was the unsuccessful treatment objective that primarily contributed for a more deficient occlusal result in complete Class II malocclusions;

Treatment time similarity was the determinant factor for the similar treatment efficiency indexes of both malocclusions.

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