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Research Article

Treatment Efficiency of Class I Four-Premolar and Class II Malocclusion Two Maxillary Premolar Extraction Protocols

Janson G, Francisco R, Valerio MV* and Garib D
Department of Orthodontics. Bauru Dental School, University of São Paulo, Brazil

***Corresponding author:** Valerio MV, Department of Orthodontics, Bauru Dental School, University of São Paulo, Brazil

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Abstract

It is speculated that there are better results in treatment success rate and efficiency when posterior teeth Class II anteroposterior discrepancy does not have to be corrected during treatment. Thus, this study aimed to compare the efficiency of 4-premolar extraction protocol in Class I malocclusion and 2-maxillary premolar extraction protocol in complete Class II malocclusions. Group 1 consisted of fifty patients retrospectively selected, initially presenting with Class I malocclusion, with an initial mean age of 13.66 years. Group 2 consisted of 36 patients initially presenting with full Class II malocclusion, with an initial mean age of 14.47 years. To assess the treatment efficiency index of each treatment protocol, the Peer Assessment Rating (PAR) index was evaluated on the initial and final dental casts. Treatment efficiency index was calculated as the ratio between the percentage of PAR reduction and the treatment time. The occlusal outcomes at the post-treatment stage were evaluated by the PAR and OGS (Objective Grading System) indexes. T tests for independent samples were used for intergroup comparisons of the initial age, initial and final PAR, PAR reduction, PAR reduction percentage, treatment time, treatment efficiency, total OGS and OGS variables. Non-parametric Mann-Whitney U-tests were used for intergroup comparison of the final PAR occlusal variables and two OGS variables. There were no intergroup differences regarding PAR reduction, PAR reduction percentage, treatment time and treatment efficiency. Additionally, the occlusal outcomes at the post-treatment stage were similar in the groups. The treatment efficiency and the occlusal outcomes were similar for both protocols.

Keywords: Malocclusion; Class I malocclusion; Class II malocclusion; Tooth Extraction; Efficiency

List of Abbreviations

TEI: Treatment Efficiency Index; IAge: Initial age; TT: Treatment time; PAR: Peer Assessment; Rating; IPAR: Pretreatment Peer Assessment Rating Index; FPAR: Posttreatment Peer Assessment Rating Index; PAR-Red: Peer Assessment Rating Index Reduction (IPAR – FPAR); PcPAR: The percentage of PAR reduction; ABO: American Board of Orthodontics; OGS: Objective Grading System; RF: Study examiner; SD: Standard Deviation

Introduction

It has been demonstrated that the 2-maxillary premolar extraction protocol provides better treatment success rate and has shorter treatment time than 4-premolar extraction or non-extraction treatment protocols of complete Class II malocclusion [1-3]. Additionally, treatment efficiency is greater in the 2-maxillary premolar extraction protocol than in the non-extraction protocol of complete Class II malocclusion [3]. Treatment time in 4-premolar extraction and non-extraction protocols of complete Class II malocclusions are similar [4]. Therefore, it is speculated that there are better results in treatment success rate and efficiency, and shorter treatment time in the 2-maxillary extraction protocol compared to the other two because posterior teeth Class II anteroposterior discrepancy does not have to be corrected and consequently smaller patient compliance in using removable anchorage reinforcement devices is necessary [1-6]. When Class I malocclusions treated with 4-premolar extractions were compared to complete Class II malocclusions, also treated with 4-premolar extractions, the results demonstrated better occlusal results and greater occlusal changes in the first group, corroborating this speculation [7].

Therefore, to further investigate this speculation, the objective of this study was to compare the efficiency of 4-premolar extraction protocol in Class I malocclusion and 2-maxillary premolar extraction protocol in complete Class II malocclusion treatments, testing the null hypothesis that there is no intergroup difference.

Materials and Methods

This study was approved by the Ethics in Research Committee. Sample size calculation showed that 17 patients were needed in each group, considering an 80% of test power at a significance level of 5%, to detect an intergroup difference of 1.26, with an estimated standard deviation of 1.26 in the Treatment Efficiency Index (TEI) [3].

Eighty-six patients were retrospectively selected from the files of the Orthodontic Department, divided into 2 groups. Group 1 consisted of 50 patients initially presenting with Class I malocclusion

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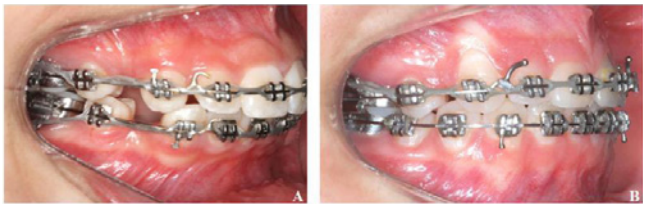

Figure 1: A-Group 1, Class I malocclusion treated with four premolar extractions; 1B-Group 2, Class II malocclusion treated with two maxillary premolar extractions.

Table 1: Error study (Dahlberg´s formula and t test).

Variables	1st Measurement		2nd Measurement		Dahlberg	P
	Mean	S.D	Mean	S.D		
IPAR	31.20	9.86	32.20	10.63	2.05	0.126
FPAR	2.60	2.03	2.65	2.05	0.94	0.871
OGS	27.00	7.05	28.00	7.88	2.75	0.260

Table 2: Intergroup comparability (t and Chi-square tests).

	Group 1 – Class I (n=50)		Group 2 – Class II (n=36)		P
	Mean	S.D	Mean	S.D	
I-Age	13.66	1.89	14.46	2.93	0.13 €
IPAR	28.76	11.74	26.19	6.91	0.24 €
Sex:					
Male	23		20		0.381¥
Female	27		16		

€ - t test
¥ - Chi-square test

treated with 4-premolar extractions, with an initial mean age of 13.66 years (Figure 1a). Group 2 consisted of 36 patients initially presenting with complete Class II malocclusion [8,9] treated with 2-maxillary premolar extractions, with an initial mean age of 14.47 years (Figure 1b).

Patients should also present the following additional selection criteria: permanent dentition and presence of all maxillary and mandibular permanent teeth up to the first molars, absence of supernumerary and impacted teeth, agenesis and anomalies of size and/or shape of the teeth, no maxillary expansion, no facial trauma or medical history that could have altered the apical bases normal growth, no previous orthodontic treatment, records in satisfactory conditions, and availability of initial and final study models and final panoramic radiographs. Additionally, all patients should have been treated with immediate extractions, without replanning and use of absolute anchorage with mini-implants.

All patients were treated with standard edgewise or preadjusted fixed appliances (Roth prescription), with 0.022x0.028-inch slots, and functional appliances were not used. After the extractions, the canines are initially retracted a small amount to allow space for leveling and alignment. The usual wire sequence consisted of 0.015-inch Twist-Flex or 0.014 or 0.016-inch Nitinol, followed by 0.016, 0.018, 0.020 and finally 0.021 x 0.025 or 0.019 x 0.025-inch stainless steel archwires. Thereafter, en-masse retraction of the anterior teeth was performed. When anchorage reinforcement was necessary, extraoral headgear and lip bumpers were used. Class II elastics were used in the Class II malocclusion group to aid in correcting the Class II anteroposterior relationship. Deep bites were usually corrected with accentuated and reversed curve of Spee in the archwires. Posttreatment retention consisted in a Hawley plate in the maxillary arch and bonded mandibular canine to canine retainers.

Sex, initial (IAge) and the treatment time (TT) were obtained from the patients' clinical charts. Treatment time was calculated from the day of fixed appliance installation until the day of appliance removal.

PAR Index

The Peer Assessment Rating (PAR) index [10], was calculated in the Pretreatment (IPAR) and Posttreatment (FPAR) dental study models, according to the American weightings [11].

The degree of occlusal improvement (PAR reduction - PAR-Red) was calculated as the difference between the pretreatment and posttreatment scores (PAR-Red = IPAR – FPAR). The percentage PAR reduction (PcPAR) was calculated as IPAR-FPAR/IPAR x 100%, which reflects the PAR change in relation to the initial score. The Treatment Efficiency Index (TEI) was calculated as the rate between PcPAR and TT (months) expressed by TEI = PcPAR/TT [3,12,13].

Because the PAR index analyzes a set of occlusal characteristics at the same time and does not discriminate the participation degree of each in the total score, the posttreatment scores obtained for each PAR component were individually compared 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.

OGS Index

The American Board of Orthodontics (ABO) Objective Grading System (OGS index), was used for evaluation of the orthodontic treatment results [14]. The OGS index consists of evaluation of eight items (alignment, marginal ridges levels, buccolingual inclination, overjet, anteroposterior occlusal relationships, occlusal contacts, interproximal contacts and roots parallelism). To evaluate the casts, a metal gauge with 0.5 mm thickness and 1.0 mm height was used (ABO Measuring Gauge, St. Louis, USA). This thickness and height allow it to be used as a parameter to measure deviations from normal [14].

For each failure, one or two points were subtracted from the case, depending on the severity of the problem. The final individual OGS index corresponded to the sum of lost points in each of the eight factors [14].

Similar to the PAR index, the posttreatment scores obtained for each OGS component were individually compared to determine the success rate achieved in each group.

Error study

Twenty patients were randomly selected (10 from each group) and the post treatment OGS and the pre- and post treatment PAR indexes were recalculated by the same examiner (RF), 30 days after the first evaluation. Random errors were estimated with Dahlberg's

formula, Se2 = ∑d2/2n [15], where S2 is the error variance and d is the difference between 2 determinations of the same variable, and the systematic errors were evaluated with dependent t tests, at P<0.05 [16].

Statistical analyses

For each variable in both groups, the means and standard deviations (SD) were calculated. Normal distribution of the variables was verified by Kolmogorov-Smirnov tests. The results showed that all PAR components and two components of the OGS index were not normally distributed. Therefore, t tests were used for intergroup comparisons of the normally distributed variables and Mann-Whitney U-tests were used for the other variables. Chi-square test was used to compare sex distribution in the groups. All tests were performed with Statistica software (Release 7, StatSoft Inc., Tulsa, OK, USA). Results were considered significant at P < 05.

Results

The random errors ranged from 0.94 (FPAR) to 2.75 (OGS) and were within acceptable levels [7,17]. There were no significant systematic errors (Table 1).

The groups were comparable regarding initial age, initial malocclusion severity (IPAR) and sex distribution (Table 2).

There were no intergroup differences regarding the FPAR, OGS, PAR-Red, PcPAR, Treatment Time (TT) and treatment efficiency index (TEI, Table 3).

At the post-treatment stage group 2 showed better anteroposterior relationship, smaller adjacent marginal ridge discrepancies and better root angulation than group 1 (Table 4).

Table 3: Intergroup comparison (t test).

Variables	Group 1 – Class I (n=50)		Group 2 – Class II (n=36)		P
	Mean	S.D.	Mean	S.D.	
FPar	3.82	3.4	2.75	2.31	0.106
OGS	28.24	7.56	26.47	9.45	0.338
PAR-Red	24.94	11.73	23.44	6.93	0.496
PcPAR	84.02	15.98	88.96	10.82	0.111
TT	28.81	10.49	25.86	8.37	0.166
TEI	3.24	1.2	3.78	1.31	0.053

Table 4: Intergroup comparisons of the individual FPAR and OGS index components (Mann-Whitney U-test and t test).

Variables	Group 1 – Class I (n=50)		Group 2 – Class II (n=36)		P
	Mean	S.D.	Mean	S.D.	
FPAR - Antero-superior Displacement	0.3	0.61	0.33	0.58	0.71 €
FPAR - Antero-inferior Displacement	0.12	0.32	0.11	0.39	0.80 €
FPAR - Antero-posterior Relationship	1.96	1.53	1.22	1.53	**0.04 €**
FPAR - Posterior Occlusion - Vertical	0	0	0	0	--------
FPAR - Posterior Occlusion - Transversal	0.36	1.12	0.33	1.01	0.95 €
FPAR – Overjet	0.3	1.19	0	0	0.64 €
FPAR - Overbite	0.78	1.32	0.66	1.26	0.77 €
FPAR - Midline	0	0	0.08	0.5	0.83 €
Total F-Par	3.82	3.4	2.75	2.3	0.106¥
OGS - Alignment	4.52	2.32	4.77	2.5	0.624¥
OGS - Marginal Ridges	3.14	1.91	2.33	1.65	**0.044¥**
OGS - Buccolingual Inclination	3.56	2.33	2.8	2.12	0.128¥
OGS - Occlusal Relationship	3.7	2.94	3.19	3.16	0.448¥
OGS - Occlusal Contacts	5.08	2.86	4.97	2.77	0.861¥
OGS - Overjet	4.16	2.7	4.55	3.01	0.43 €
OGS - Interproximal Contacts	1.48	1.19	1.97	1.99	0.49 €
OGS - Roots Angulation	2.6	1.56	1.86	1.53	**0.032¥**
Total OGS	28.24	7.56	26.47	9.45	0.338¥

€ - Mann-Whitney U-test
¥ - T test

Discussion

Groups comparability

The amount of Class I malocclusion patients found in the file was greater than that of Class II malocclusion patients. To match the groups according to the malocclusion severity it was necessary the select the most severe Class I malocclusions to compensate for the anteroposterior discrepancy of the Class II malocclusion (Table 2).

The treatments were supervised by the same team of professors to ensure uniformity in the protocols and mechanics used. Class II patients were treated with immediate extraction, because replanning increases the treatment time, which could influence the results [2,18].

Intergroup comparisons

The groups were similar regarding the FPAR, OGS, PAR-Red, PcPAR, Treatment Time (TT) and Treatment Efficiency Index (TEI, Table 3). This demonstrates that the different treatment protocols for these different malocclusions can provide similar occlusal results and changes in a similar time, producing consequently, similar treatment efficiency. However, this contradicts previous reports that concluded that the number of extractions increase the treatment time [19-21]. This relationship is not so simple because malocclusion type, severity and the protocol of malocclusion correction have to be taken into account. The amount of extractions may be consequent to the malocclusion severity [22,23]. The greater the malocclusion severity, the greater is the treatment time [2,24]. Malocclusion treatment protocol also plays a role in determining treatment time in complete Class II malocclusion treatment [2-4]. It has been shown that treatment time is shorter, with better occlusal outcomes in complete Class II malocclusion treatment, when performed with two-maxillary premolar extractions than when treated non-extraction or with four premolar extractions [1-3]. It has been speculated that this is because in these last two protocols, patient compliance is necessary to correct the molar Class II anteroposterior discrepancy, either with Class II intermaxillary elastics and/or with extraoral headgear [2-5]. In the two-maxillary premolar extraction protocol, much less patient compliance is needed with the use of these devices [2,3,6].

The current results support this speculation because in both

malocclusions the initial anteroposterior molar relationship does not have to be corrected with the studied protocols. Therefore, small and similar patient compliance are needed in both malocclusions and treatment protocols. One may argue that there could be a difference in the Class I malocclusion four-premolar extraction group depending on the degree of anchorage necessary for anterior retraction. Because the patients in this group were not selected according to this criterion, it is very likely that the amount of patients requiring minimum or maximum anchorage would be evenly distributed. Therefore, it can be considered that the group represented patients with mean anchorage reinforcement needs.

It is interesting to notice that the FPAR provided similar intergroup comparison result as the OGS. The PAR index was not intentionally developed to evaluate the treatment results as the OGS [10,25]. However, the current results demonstrate that it can provide similar estimates of the finishing quality of orthodontic cases, within certain limitation.

The PAR index and the OGS allow individual intergroup comparison of their components that can demonstrate specific differences in the final occlusal results in each group. The Class II group demonstrated a significantly better anteroposterior occlusion than the Class I group for the FPAR index (Table 4). This shows that the two-maxillary premolar extraction mechanics was better than the four-premolar extractions in the Class I malocclusion. Probably the need to close the maxillary and mandibular extraction spaces, which require different anchorage degrees, may have led to lack of control of the anteroposterior relationship during the mechanics in the Class I group. However, additional research is required to support this hypothesis.

The Class II group also showed better marginal ridge alignment and root parallelism than the Class I group, for the OGS (Table 4). This, perhaps, was consequent to the greater number of extraction spaces that had to be closed in the Class I group, which had extractions in the four quadrants, compared to the Class II group, which had extractions only in the maxillary quadrant. Marginal ridge alignment and root parallelism are more difficult to be obtained in the extraction sites [8,26,27]. Therefore, these better results for the Class II group demonstrate a slightly better occlusal finishing for this group. However, the overall PAR index and OGS did not demonstrate any intergroup difference. Therefore, these results support the investigated speculation.

Conclusion

- The null hypothesis was accepted because there were no intergroup differences regarding:
- The final occlusal results;
- The amount and percentage of occlusal improvement;
- The treatment time and;
- The treatment efficiency index of Class I four-premolar and Class II malocclusion two-maxillary premolar extraction protocols.

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