Comparison of the occlusal outcomes and treatment time of Class II malocclusion with the Pendulum appliance and with two maxillary premolar extractions

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Abstract

Objectives: The purpose of this study was to compare the occlusal outcomes and the treatment time of Class II malocclusion with the Pendulum appliance and with two maxillary premolar extractions. **Methods:** For this, 48 Class II malocclusion patients were selected and divided into two groups according to the treatment protocol: group 1 consisted of dental study casts and initial cephalograms of 22 patients treated with the Pendulum appliance, with an initial mean age of 14.44 years and group 2, comprised of dental study casts and initial cephalograms of 26 patients treated with two maxillary premolar extractions and a initial mean age of 13.66 years. The occlusal outcomes were evaluated on dental casts with the PAR occlusal index and the treatment time of each group was calculated by the clinical records. The variables were compared by the t tests. **Results and conclusions:** The results demonstrated that the occlusal outcomes were similar between the groups, however, the two maxillary premolar extractions protocol provided occlusal outcomes in a shorter treatment time than the Pendulum treatment.

Keywords: Class II. Pendulum. Extractions. Distalization.

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INTRODUCTION

The Class II malocclusion is considered as the most frequent treatment problem in the orthodontic practice.[6,27] It occurs because of the aesthetic and functional imbalance related to this malocclusion. So the various treatment protocols described in the literature for the Class II malocclusion correction cause an interest in the orthodontic community.

The orthodontic treatment plan decision of Class II malocclusion depends on the characteristics associated with the malocclusion (anteroposterior, transversal and vertical discrepancies), age, patient compliance, psychological implications, stability, financial conditions, treatment time and treatment efficiency degree.[3,22,23]

Orthodontists, patients and patients' parents are worried about the clinical effectiveness of the orthodontic procedures. They want to obtain the best results in the least amount of time.[3] So, when more than one treatment protocol is indicated to treat the same malocclusion, the clinician should also consider the treatment efficiency.[3]

Treatment of dental Class II malocclusion, without significant skeletal involvement, reduced potential of craniofacial growth and without crowding or cephalometric discrepancy in the mandibular arch, can be performed with maxillary molar distalization or with maxillary premolar extractions.[14,16]

Among the appliances available to molar distalization, is the Pendulum appliance that was proposed by Hilgers,[16] in 1992. This device was developed to treat the Class II malocclusion non-compliance patients. Studies[7,8,13] demonstrated the effectiveness of the Pendulum appliance to molar distalization, but with some undesirable effects as distal tipping of the molars, anchorage loss, expressed as mesial movement and tipping of the canines and the premolars, proclination of the incisors and increase at the lower anterior facial height. According to the authors, this undesirable effects are corrected during the orthodontic fixed appliance that follows molar distalization.[7,8,13] However, after the distalization phase is indicated the use of the headgear to correct the molar distal tipping and to maintain the molar relationship corrected during the anterior teeth retraction since these teeth are used as anchor units.[13]

The protocol that involves the maxillary premolar extractions to treat the Class II malocclusion has been widely discussed in literature. To indicate the maxillary premolar extractions, the clinician must evaluate the Class II severity, craniofacial growth pattern, age, patient compliance and the facial profile between other factors.[4] The decision to extract or to not extract may influence the occlusal and facial results, the parents and patients' satisfaction and the treatment duration.[25,28]

Studies have demonstrated that this protocol produces a better occlusal result than the four premolar extractions protocol[17] and also than the nonextraction protocol.[3] Besides, recent studies demonstrated that the treatment time was smaller for the groups initially planned with extractions of two upper premolar.[3,21]

Evaluating these two protocols to treat the dental Class II, the following considerations were elaborated:

- using the Pendulum appliance, a "space" similar of that obtained with the premolar extraction is created, and this space need to be closed with adequate patient compliance to correct the molar tipping and to retract the anterior teeth without significant anchorage loss. In patients with limited compliance, can this treatment protocol result in a longer treatment time and/or an occlusal unsatisfactory result?

- the protocol that involves the maxillary premolar extractions spend a longer treatment time?

To investigate these considerations, the aim of this study was to compare the occlusal results and the treatment time of the Class II malocclusion treatment with the Pendulum appliance and with two maxillary premolar extractions.

MATERIAL AND METHODS

Material

The sample was retrospectively selected from the files of the orthodontic department at Bauru Dental School in Brazil. The criteria for patient selection included the following: Class II malocclusion, treated with the Pendulum appliance or with maxillary premolar extractions; treatment finished with fixed edgewise appliances (standard or pre-adjusted—Roth prescription), presence of all permanent teeth up to the first molars and no dental anomalies of number, size and form.

The sample was consisted of the dental study models and the lateral radiographs of 48 patients, divided into two groups, according to the treatment protocol (Table 1).

TABLE 1 - Initial characteristics of the groups.

	GROUP 1 (N = 22) (PENDULUM)	GROUP 2 (N = 26) (EXTRACTIONS)
INITIAL AGE		
Mean	14.44	13.66
Standard deviation	1.85	0.91
Minimum age	11.6	12
Maximum age	17.65	15.08
GENDER DISTRIBUTION		
Male	7	15
Female	15	12
ANTEROPOSTERIOR DISCREPANCY		
Complete Class II	6	26
¾ of Class II	6	0
½ Class II	6	0
¼ Class II	4	0
TYPES OF CLASS II MALOCCLUSION		
Class II division 1	19	22
Class II division 2	3	4

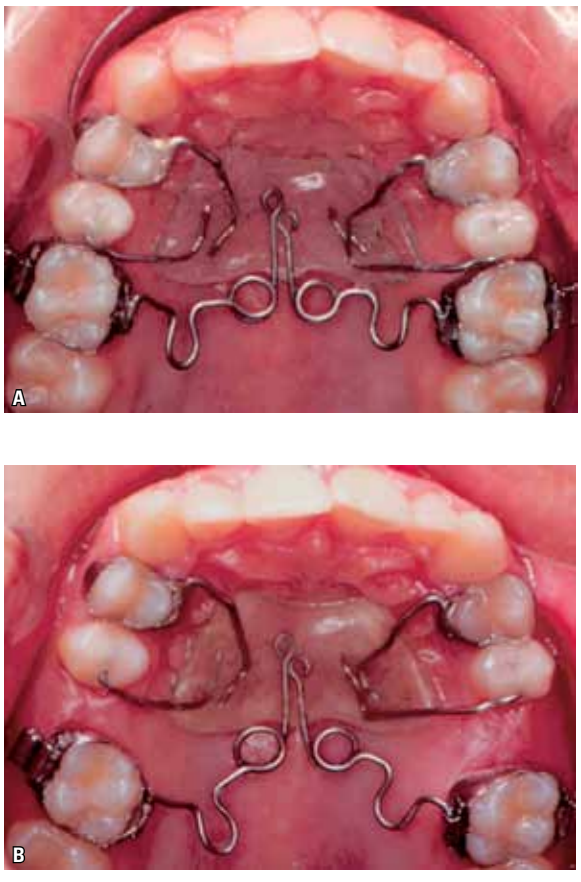

FIGURE 1 - Pendulum appliance (**A** – treatment onset; **B** – after molar distalization).

Orthodontic treatment

Group 1

This group belongs to a sample that was prospectively treated by only two orthodontists. The pendulum appliance was used to correct the Class II malocclusion, with the release of a force of 230-250 g per side, during the average time of 5.85 months (SD = 1.82). The appliance was left in place until an overcorrected Class I molar relationship was achieved. After removal of the Pendulum appliance, a Nance button was used to retain the distalized first molars. Anchorage reinforcement was achieved with a cervical headgear exerting 400-500 g of force per side, with an average wear time of 10-12 hours per day.

After 30 days, pre-adjusted edgewise orthodontic appliance was placed to initiate leveling and alignment. During use of the 0.019 x 0.025-in rectangular arch, sequential retraction of the second premolars followed by the first premolars was initiated with elastic chains and with the aid of cervical headgear worn at night. After retraction of the first premolars, the Nance button was removed for retraction of the anterior teeth. At this stage, besides the cervical headgear, Class II elastics were also used for anchorage reinforcement and to reduce the increased overjet produced by the side effects of the appliance. After retraction of the maxillary anterior teeth, ideal archwires were inserted for the finishing procedures. After removal of the fixed orthodontic appliance, conventional Hawley and 3 x 3 retainers were placed.

Group 2

The group 2 comprised 26 patients treated with two maxillary premolar extractions. All patients were planned with two maxillary premolar extractions at treatment onset (Fig 2).

Orthodontic mechanics included fixed edgewise appliance, with 0.022 x 0.028-in.

FIGURE 2 - Treatment with two maxillary premolar extractions.

The extraoral headgear was used to reinforce anchorage. The orthodontic mechanics followed the conventional sequence: leveling and aligning (usual wire sequence characterized by the use of nitinol alloy wire initially, followed by round stainless steel wires until the 0.019 x 0.025-in), anterior retraction, intercuspation and finishing procedures. Class II elastics were also used to help in maintaining Class II molar relationship. After removal of the fixed orthodontic appliance, conventional Hawley and 3 x 3 retainers were placed.

METHODS

Records

The patients' records were used to determine the initial age, gender, date of treatment onset, date of treatment completion and total treatment time (TT). Also they were used to check the treatment protocols and to confirm that there were no delayed extractions in the groups.

Occlusal results

The PAR[24] (Peer Assessment Rating index) index was calculated on the pre (IPAR)

and posttreatment (FPAR) dental study models of each patient, according to the American weightings suggested by De Guzman et al.[11]

This index was selected due to the proven validity that possesses in quantitatively express a certain occlusal condition, for its reliability and reproducibility of the results, for being elaborated and thoroughly used with the purpose of evaluating the results of the orthodontic treatment and for being objective and easily applicable[3,11,24].

Cephalometric evaluation

The lateral cephalograms were traced on acetate paper, and the cephalometric tracings and landmark identifications were performed by a single investigator and then digitized with a Numonics AccuGrid XNT, model A30TL.F digitizer (Numonics Corporation, Montgomeryville, PA). These data were stored on a computer and analyzed with Dentofacial Planner 7.02 (Dentofacial Planner Software, Toronto, Ontario, Canada), which corrected the image magnification factors of the groups, that were 6%, 7.4% and 9.8%, depending on which X-ray machine they had been taken.

Error study

Twenty pairs of dental study models and fifteen randomly selected radiographs were remeasured by the same rater. The casual error was calculated according to Dahlberg's formula ($Se^2=\Sigma d^2/2n$, where Se^2 is the error variance and *d* is the difference between the 2 determinations of the same variable) and the systematic error with dependent *t* tests, for $p < 0.05$.

Statistical analysis

Means and standard deviations for each variable were calculated to enable characterization of both groups.

Compatibility of the groups regarding the gender distribution, proportions of Class II Divisions 1 and 2 malocclusions and the anteroposterior severity of Class II malocclusions were evaluated with chi-square tests.

Independent t test was used to evaluate the compatibility between the initial cephalometric characteristics, the initial age and the occlusal characteristics of the groups at the initial treatment stage (IPAR).

T test was also used to compare the groups regarding occlusal outcomes (FPAR) and treatment time (TT).

Results were considered to be statistically significant for $p < 0.05$.

These analyses were performed with Statistica software (Statistica for Windows version 6.0, Statsoft, Tulsa, Okla, USA).

RESULTS

No statistically significant systematic errors were detected in the occlusal evaluation and the casual errors were within acceptable levels (Dahlberg: 0.52 and p: 0.13). In the cephalometric evaluation, only two statistically significant systematic errors were detected: overbite, $p = 0.025$ and LS-E, $p = 0.045$. The range of casual errors varied from 0.29 to 3.94, with 25 variables below 1 degree or millimeter, 4 below 2 degrees or millimeters and only one variable above this level.

The groups were compatible regarding the gender distribution, the types of Class II malocclusion, the maxillary component, the maxillomandibular relationships, the vertical components, the mandibular dentoalveolar component, the skeletal and soft tissue profile and the initial age (Tables 2, 3 and 4).

The group 2 had greater Class II anteroposterior discrepancy, a more retruded mandible, greater maxillary incisors proclination and protrusion, overjet, molar Class II relationship and malocclusion severity than the group 1(Tables 2, 3 and 4).

There was no difference between the groups

TABLE 2 - Results of independent t test to evaluate the initial cephalometric compatibility between the groups.

MEASUREMENTS	GROUP 1 (N = 22) (PENDULUM)		GROUP 2 (N = 26) (EXTRACTIONS)		P
	Mean	SD	Mean	SD	
MAXILLARY COMPONENT					
SNA (°)	82.75	3.16	81.17	3.72	0.1254
Co-A (mm)	85.99	5.21	85.92	6.63	0.9691
A-Nperp (mm)	1.31	3.03	-0.63	4.00	0.0680
MANDIBULAR COMPONENT					
SNB (°)	78.08	2.76	76.94	2.61	0.1493
Co-Gn (mm)	108.34	5.21	108.39	6.60	0.9786
Pog-Nperp (mm)	-3.53	4.76	-6.86	6.10	0.0431
MAXILLOMANDIBULAR RELATIONSHIP					
ANB (°)	4.68	1.60	4.23	2.56	0.4778
WITS (mm)	3.39	2.31	4.70	2.20	0.0505
Co-A/Co-Gn (mm)	79.36	2.39	79.28	3.98	0.9287
VERTICAL COMPONENTS					
FMA	24.71	5.41	26.53	4.91	0.2296
SN.GoGn	31.32	6.04	32.57	4.82	0.4284
SN.PP	6.41	3.80	4.94	2.88	0.1343
LAFH	63.61	4.71	64.79	5.40	0.4292
MAXILLARY DENTOALVEOLAR COMPONENT					
U1.PP (°)	108.98	6.44	114.10	8.57	0.0258
U1.NA (°)	19.83	7.79	27.97	9.68	0.0027
U1-NA (mm)	3.44	2.43	7.21	4.10	0.0004
MANDIBULAR DENTOALVEOLAR COMPONENT					
IMPA (°)	94.71	4.72	93.58	5.89	0.4719
L1.NB (°)	26.16	5.22	25.15	6.29	0.5543
L1-NB (mm)	4.93	2.38	4.91	2.43	0.9813
DENTOALVEOLAR RELATIONSHIPS					
overjet (mm)	4.45	1.20	7.62	2.62	0.0000
overbite (mm)	4.88	1.85	4.11	2.74	0.2668
molar relationship (mm)	0.93	0.85	3.80	0.73	0.0000
SKELETAL AND SOFT TISSUE PROFILE					
NAPog (°)	7.04	3.81	6.12	6.46	0.5595
Nasolabial angle (°)	103	13.94	111.51	16.75	0.0647
H-nose (mm)	2.86	3.52	3.56	3.55	0.5046
Ls-E (mm)	18.37	1.62	18.88	2.84	0.4564
Li-E (mm)	14.68	2.16	15.91	2.58	0.0897

in relation to the occlusal results obtained with the different treatment protocols evaluated (Table 4).

The results showed a shorter treatment time to the maxillary premolars extraction group (group 2 - Table 4).

TABLE 3 - Results of chi-square test to evaluate the compatibility of gender distribution, types of Class II malocclusion and the severity of initial molar anteroposterior discrepancy between the groups.

VARIABLES	GROUP 1 (N = 22) (PENDULUM)	GROUP 2 (N = 26) (EXTRACTIONS)	X^2	P
GENDER DISTRIBUTION				
male	7	14	2.35	0.1253
female	15	12	2.35	0.1253
TYPES OF CLASS II MALOCCLUSION				
Class II division 1	19	22	0.03	0.8642
Class II division 2	3	4	0.03	0.8642
ANTEROPOSTERIOR DISCREPANCY				
Complete Class II	6	26	28.36	0.000
¾ of Class II	6	0	28.36	0.000
½ Class II	6	0	28.36	0.000
¼ of Class II	4	0	28.36	0.000

TABLE 4 - Results of independent t tests between the groups.

VARIABLES	GROUP 1 (N = 22) (PENDULUM)		GROUP 2 (N = 26) (EXTRACTIONS)		P
	Mean	SD	Mean	SD	
Initial age	14.44	1.85	13.66	0.91	0.0626
IPAR	15.91	5.12	24.62	7.58	0.0000
FPAR	4.23	3.74	2.92	3.16	0.1968
TT (months)	45.70	12.18	23.01	6.01	0.0000
Ttrat (years)	3.81	1.01	1.92	0.50	0.0000

DISCUSSION

Methodology

In the cephalometric evaluation, two statistically significant systematic errors (overbite and LS-E) were detected, with differences smaller than 1 mm between the first and the second measurement. Three casual errors (1.PP, 1.NA and nasolabial angle) were also detected, the range of casual errors varied from 0.29 to 3.94, with 25 variables below 1 degree or millimeter, 4 below 2 degrees or millimeters and only one variable above this level. Since the most part of the errors showed a variation smaller than 1 mm and 1 degree between the measurements and considering that the systematic errors occurred in only 2 from the 27 measures (7,4%), the results observed may be considered reliable.

Probably due to the easy reproducibility of the PAR index and the calibration of the author prior to the measurements, in the occlusal evaluation, no statistically significant systematic errors were detected and the casual errors were within acceptable levels.

Compatibility of the groups

The groups initial cephalometric compatibility regarding the maxillary component, the maxillomandibular relationships, the vertical components, the mandibular dentoalveolar component, the skeletal and soft tissue profile (Table 2) reduces the critical to the not randomized studies,[6] allowing the comparison between the groups.

The groups were similar regarding the gender distribution (Table 3), so this variable not influenced the obtained results related to some kind of sexual dimorphism as skeletal maturation, growth rate or levels of compliance. The female individuals demonstrated in several studies a more precocious maturation time, a more accelerated growth rhythm[29] and a greater cooperation during the treatment[10].

The patients with Class II division 2 malocclusion were included in the sample because the groups were compatible regarding the types of Class II malocclusion (Table 3) and also because correction of the dentoalveolar anteroposterior discrepancy is similar in both types.[18] Besides, the larger score of the PAR from a larger overjet in the Class II division 1 subjects would be compensated by the larger overbite and crowding in the Class II division 2 subjects.[3,17] The anchorage reinforcement would also be similar because of the greater labial crown torque that should be applied to the maxillary incisors to correct their inclination and to retract them in the Class II division 2 subjects. So their inclusion should not have interfered with the results.[3,17,18]

The groups were also similar regarding the initial age (Table 4). This is an important factor in this evaluation because the results usually have to be more favorable to younger patients. The mandibular growth helps to achieve desired sagittal relationships in the Class II correction.[15] Harris; Dyer and Vaden[15] demonstrated that differential mandibular growth in the Class II adolescents (mean age of 12.5 years) contributed 70% of the total molar correction, with orthodontic tooth movement accounting for the remaining 30%.

Cephalometrically, the differences between the groups at treatment onset in relation to the labially tipped and protruded maxillary incisors (Table 2) were expected, since the Pendulum appliance results in anchorage loss, with proclination of the incisors and increase in overjet,[7,8,13] so the use of Pendulum appliance is not recommended in cases with large overjet in treatment onset.[27]

The initial malocclusion severity was not similar among the groups (Tables 2, 3 and 4), because in the group 1 the patients were prospectively treated and no criterion related to the initial malocclusion severity was included

to select the patients. In group 2 all patients showed a complete bilateral Class II malocclusion at treatment onset. The patients of this group already were evaluated in others studies[3,17] elaborated at Orthodontic Department at Bauru Dental School in Brazil. This way, the groups were not compatible as to the initial malocclusion severity, demonstrated by the cephalometric measurements horizontal overjet and molar relationship, and for the initial values of the PAR index (Tables 2, 3 and 4).

Occlusal results

The final occlusal status was similar between the groups (Table 4). In accordance with Richmond et al,[24] when the final PAR value is 5 or less, suggests an almost ideal occlusion. In the two groups, the final PAR were less than 5 (Pendulum: 4.23 and maxillary premolar extractions: 2.92), so to both protocols the cases could be considered well finished.

Treatment time

Treatment time of the Pendulum followed by fixed appliances was longer than to the maxillary premolar extractions (Table 4). The treatment time to group 1 was 45.7 months (3.81 years) while to the group 2 was 23.01 months (1.92 years).

One of the undesirable effects of Pendulum appliance treatment is distal tipping of the molars. Bussick and McNamara[7] report a molar distal tipping of 10.6°, Ghosh and Nanda[13] of 8.4°, Byloff and Darendeliler[8] of 14.5° and Burkhardt; McNamara and Baccetti[6] of 10°. Incorporating an uprighting bent into the distalizing springs, Byloff et al[9] reduced molar distal tipping to 6.1°, but the distalization treatment time increased 64.1%.

The molar distal tipping may cause the molar correction relapse, due to the impossibility of the correct force distribution. In addition, anchorage loss of maxillary molars in terms of mesial movement may takes place, since at this stage of treatment these teeth are used as anchor units[27] for the subsequent anterior teeth retraction that follows molar distalization. So, in this phase of the treatment, anchorage reinforcement is essential.

In the literature, the Pendulum is considered a minimal-compliance appliance because it does not require patient compliance in wearing removable anchorage reinforcing devices during distalization of the posterior segment. However, the most part of the studies[7,8,9,13] evaluated only the distalization results, that really do not require patient compliance. But to finish the treatment, is necessary to correct the distal molar tipping and to retract the anterior teeth maintaining the molar relationship. So the patient compliance in wearing the extraoral headgear and the Class II elastics[2,7] is essential to well finish the cases.

In Class II therapy with molar distalization, the need for anchorage reinforcement is even greater, because first the molar root must be distalized and after the molar relationship must be maintained to retract the anterior teeth. While in treatment of Class II malocclusions with two maxillary premolar extractions the use of anchorage reinforcement is require only in order to avoid mesial movement of the posterior segment during retraction of the anterior teeth, since the molar position correct is not required. Consequently, the need for anchorage reinforcement with Pendulum appliance therapy is twice as greater and treatment success will be even more dependent on patient compliance.

Besides the necessity of correction and maintain the molar relationship, the increase in anterior crowding, overjet and in upper incisors proclination[7,8,13] may also had been collaborated to a longer treatment time in group 1.

The first studies published about the Pendulum appliance only described this device[1,12] and cases reports.[5,19] The skeletal and dentoalveolar effects exist in a relatively small number,[2,7,8,9,13]

and the major part of them[7,8,9,13] evaluated only the distalization phase. Only two studies[2,6] evaluated the complete treatment, including the Pendulum followed by fixed appliances.

Treatment time of the Pendulum followed by fixed appliances was longer than the previously reported time of 31.6 months.[6] Probably this occurred because their sample age was 12.3[6] while in this study it was 14.44 years. It is known that Class II malocclusion correction is easier in younger patients,[15] because of the mandibular growth.

In the literature, there are studies that demonstrated an increase in treatment time related with teeth extractions.[25,26,28] However, recently studies demonstrated that the Class II treated with extractions showed a greater anteroposterior discrepancy.[26] So, a longer treatment time is probably related to the correction of a greater malocclusion severity[25,26,28] and not with the teeth extractions.

Moreover, in the studies[25,28] that associated a longer treatment time with the teeth extractions, the malocclusion types were not isolated. So, the results obtained should not be extrapolated to an isolate malocclusion type, since the treatment protocols may include variables that are peculiar to it, distorting the results.[3] For example, it is expected that the correction of Class I nonextraction present a shorter treatment time than the Class II nonextraction, since, for the treatment of the Class II, it is necessary first to correct the molar relationship while in Class I it is not requered.[3]

In this study, the group treated with extractions demonstrated a shorter treatment time when compared with the group treated with the Pendulum appliance. This result is in agreement with that obtained by Barros,[3] who demonstrated that the Class II malocclusion treatment with two premolar extractions showed a better occlusal success rate, in a shorter treatment time than the nonextraction protocol.

Similar result was observed by Maria,[20] who demonstrated a shorter treatment time with a more predictable occlusal result treating the Class II with two premolar extractions than with four premolar extractions. Some years latter, the same author,[21] compared the treatment time of a group treated with two premolars extraction with other treated with delayed extractions and observed a shorter treatment time to the group planned with two maxillary premolar extractions at treatment onset.[21]

It could be argued that the greater initial malocclusion severity (Tables 2, 3 and 4) of group 2 could have contributed to the results obtained. Nevertheless, this is not the case because a greater malocclusion severity would tend to increase treatment difficulty and consequently treatment time, and the opposite occurred. In spite of there was no difference among the occlusal results, the group 2 showed statistically shorter treatment time than group 1 (Table 4).

The variables that influence the treatment time as missed appointments, attachment failures between others[25] were not considered in this study, because as well as Barros,[3] it was considered that these variables have the same probability of occurrence among the groups because they representing not only the patient compliance, but also the psychosocial and behavioral characteristics of the pacients.[25] Moreover, the evaluation of the cooperation was not the purpose of this study.

Clinical implications

The decision to extract or not to extract may influence the final occlusal result, a greater or a smaller patient compliance during the therapy and the treatment time.[3,25,28]

Despite the knowledge and clinical experience are important, the cooperation of the patient has an important role in achieving the desired results.

Justify the treatment plan based only on the

good results obtained in published studies is not sufficient.[28] The treatment time also should be considered. Faced with two treatment protocols that promote satisfactory results, the treatment time may be the differential.

In Class II treatment, the treatment time and the occlusal results are related to patient compliance to achieve the correct molar relationship or to maintain the molar relationship during the anterior teeth retraction. Remaining the maxillary molars in their initial positions with the maxillary premolar extractions protocol[17,18] facility the mechanic and dispend a smaller patient compliance, while the molar relationship correction difficult and spend a longer time to the Class II orthodontic treatment.[17,18,25,28] Despite the necessity of patient compliance in the two protocols evaluated in this study, the cooperation should be greater in the cases treated with the Pendulum appliance, because of the undesirables effects of molar distal tipping and anterior anchorage loss. In the distalization protocol is necessary to correct the molar position and also to maintain the molar relationship during the anterior teeth retraction, while with maxillary premolar extractions is only necessary to maintain the molar relationship, so less patient compliance in using extraoral appliances and/or Class II elastics was necessary to finish the cases.

Despite the Pendulum appliance had demonstrated a longer treatment time, the cases were considered well finished. So, depending of the malocclusion severity, the patient age and the resistance from parents or the patients themselves to extraction, the Pendulum appliance can be used, but it is essential that the patient and/or his parents knows that are deciding by a treatment that probably will spend a longer time to be concluded.

CONCLUSIONS

The results showed a shorter treatment time to the maxillary premolars extraction group.

There was no difference between the groups in relation to the occlusal outcomes obtained with the different treatment protocols evaluated.

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