UNIVERSIDADE DE SÃO PAULO FACULDADE DE ODONTOLOGIA DE BAURU

DIEGO LUIZ TONELLO

Class II malocclusion treatment efficiency with two-maxillary premolar extractions and with the First Class appliance anchored in mini-implants

Eficiência do tratamento da má oclusão de Classe II com extrações de dois pré-molares superiores e com o aparelho First Class ancorado em mini-implantes

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"A humildade é o primeiro degrau para a sabedoria" São Tomás de Aquino

ABSTRACT

Class II malocclusion treatment efficiency with two-maxillary premolar extractions and with the first class appliance anchored in mini-implants

Introduction: In this study, we compared the treatment time (TT) and efficiency of 2maxillary-premolar-extraction protocols and First Class distalizer anchored in miniimplants (FCMI) in Class II malocclusion treatment. This study also compared in cases treated with 2-premolar extractions, whether there is difference when appointments are held once a month or at two-week intervals. Material and methods: A sample of 50 patients were divided into 3 groups, Group 1: treated with extraction of 2 maxillary premolars, 18 (eighteen) patients (10 male, 08 female), initial mean age of 14.38 ± 1.38 years and appointments monthly; Group 2: treated with FCMI, 13 (thirteen) patients (8 male, 5 female), initial mean age of 13.38 ± 1.31 years and Group 3: treated with extraction of 2 maxillary premolars; 19 (nineteen) patients (9 male, 10 female), initial mean age of 14.12 ± 1.38 years and appointments biweekly. The occlusal indexes Peer Assessment Rating (PAR) and the Objective Grading System (OGS) were used based on dental casts to calculate the percentage of occlusal improvement. In addition, was evaluated the TT, and treatment efficiency index (TEI). After verifying the normal distribution, the occlusal indexes, TT, and TEI the groups were compared with the *t* test (P<0.05). **Results:** Group 1 had a higher percentage of patients with complete class II than group 2 (66.7% and 15.4% respectively). TT in group 1 was 28.06 months, significantly less than group 2, which was 45.15 months. Group 1 was more efficient (TEI: 3.23) than group 2 (TEI: 1.95). Group 1 and group 3 presented significantly different TT (28.06 and 22.05 months, respectively); however, there was no difference in efficiency. Conclusion: Comparing group 1 versus group 2, final occlusal results were similar in both groups; however, the TT was significantly shorter in the extractions group, so it was more efficient. Now, when comparing patients treated with 2-maxillary premolars, the treatment time was significantly shorter in appointments every two weeks, but there was no difference in efficiency.

Keywords: Anchorage; Corrective; Tooth extraction

RESUMO

Eficiência do tratamento da má oclusão de Classe II com extrações de dois prémolares superiores e com o aparelho First Class ancorado em mini-implantes

Introdução: Neste estudo, comparamos o tempo de tratamento (TT) e a eficiência do protocolo de extração de 2 pré-molares superiores e do First Class appliance ancorado em mini-implantes (FCMI) no tratamento de má oclusão de Classe II. Comparamos também, nos casos de extrações de 2 pré-molares, se houve diferença quando as consultas foram realizadas uma vez por mês ou a cada duas semanas. Material e métodos: Uma amostra de 50 pacientes foi dividida em 3 grupos, Grupo 1: tratados com extração de 2 pré-molares superiores, 18 (dezoito) pacientes (10 homens, 08 mulheres), idade média inicial de 14.38 ± 1.38 anos e consultas mensais; Grupo 2: tratados com FCMI, 13 (treze) pacientes (8 homens, 5 mulheres), idade média inicial de 13.38 ± 1.31 anos e Grupo 3: tratados com extração de 2 pré-molares superiores; 19 (dezenove) pacientes (9 homens, 10 mulheres), idade média inicial de 14.12 ± 1.38 anos e consultas a cada 2 semanas. Os índices oclusais Peer Assessment Rating (PAR) e o Objective Grading System (OGS) foram utilizados nos modelos de gesso para medir a porcentagem de melhora oclusal. Além disso, foi avaliado o TT e índice de eficiência do tratamento (TEI). Após verificar a distribuição normal, os índices oclusais, TT e TEI foram comparados com o teste t (P < 0.05). **Resultados:** O grupo 1 apresentou, no início do tratamento, uma porcentagem maior de pacientes com classe II completa comparado ao grupo 2 (66.7% e 15.4%, respectivamente). O TT no grupo 1 foi de 28.06 meses, significativamente menor que o grupo 2, que foi de 45.15 meses. O grupo 1 foi mais eficiente (TEI:3.23) do que o grupo 2 (TEI:1.95). O grupo 1 e o grupo 3 apresentaram TT significativamente diferente (28,06 e 22,05 meses, respectivamente); no entanto, não houve diferença na eficiência. Conclusão: Comparando o grupo 1 versus o grupo 2, os resultados oclusais finais foram semelhantes nos dois grupos; no entanto, o TT foi significativamente menor no grupo de extrações, sendo mais eficiente. Ao compararmos pacientes tratados com pré-molares 2-maxilares, o tempo de tratamento foi significativamente menor em consultas a cada duas semanas, porém não houve diferença quanto à eficiência.

Palavras-chave: Ancoragem; Correção; Extração dentária

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LIST ABREVIATIONS AND ACRONYMS

- TT Treatment time
- FCMI First Class appliance anchored in mini-implants
- TEI Treatment efficiency index
- PAR Peer Assessment Rating
- I-PAR Initial PAR
- F-PAR Final PAR
- DifPAR Difference between I-PAR and F-PAR
- PcPAR Percentage of PAR reduction
- OGS Objective Grading System
- DifOGS Numerical difference between I-OGS and F-OGS
- PcOGS Percentage of OGS reduction
- TeiPAR Treatment efficiency index (PAR)
- TeiOGS Treatment efficiency index (OGS)
- ABO American Board of Orthodontics
- NA Number of appointments

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1 INTRODUCTION

1 INTRODUCTION

Angle, considered the father of orthodontics, in 1899 was the first to classify Class II malocclusion. (Angle, 1899) The author considered the antero-posterior position of the maxillary first molar as a reference and classified Class II as a distal position of the mandibular first molar in relation to the maxillary first molar. Subsequently, it was found that this malocclusion can present itself in several ways, such as: maxillary prognathism; mandibular retrognathism; retrusion of the lower teeth; protrusion of the upper teeth or a combination of these disharmonies, with mandibular retrognathism being considered the most prevalent. (Drelich, 1948; Fisk et al., 1953; Moyers et al., 1980; Salzmann, 1949; Servoss, 1975) Class I malocclusion is the most prevalent in the Brazilian population, (da Silva Filho; de Freitas; Cavassan Ade, 1990) however, most patients seeking orthodontic treatment are Class II patients, since this malocclusion generally causes aesthetic, functional and phonetic disharmony. (Bishara; Cummins; Jakobsen, 1995; Bishara et al., 1995).

Class II malocclusion treated with extractions of 2 premolars has shown good occlusal, aesthetic results and reduced treatment times.(Janson et al., 2007a; Janson et al., 2004; Janson et al., 2014; Janson et al., 2007c; Janson et al., 2016b; Pinzan-Vercelino et al., 2009; Vig et al., 1990) Comparing complete Class II treatments with extraction of 2 versus 4 premolars, studies show that the cases treated with only 2 extractions were faster and produced better occlusal results compared to the cases of 4 extractions. (Janson et al., 2007c; Janson et al., 2008) Other studies compared Class II maloclusion cases treated without extractions and with extractions of two maxillary premolars and the results showed that the cases treated with extractions had better rates of final occlusal quality and in less time of treatment, that is, greater efficiency than the protocol without extractions. (Garib et al., 2016; Janson; Araki; Camardella, 2012; Janson et al., 2007a; Janson et al., 2014; Janson et al., 2010; Janson et al., 2007b; Janson et al., 2007c; Janson et al., 2016a; Janson et al., 2016b; Janson et al., 2009; Salzmann, 1949) In addition, unlike cases treated with distalizers, treatment with maxillary premolar extractions has a better prognosis for the eruption of third molars.(Janson et al., 2007b; Janson et al., 2006)

Another alternative to Class II dental treatment would be the distalization of all upper teeth with intraoral distalizers appliances. In general, these appliances first distalize the molars leading them to a Class I relationship, then the molars are anchored to distalize the other anterior teeth. Distalizers do not require tooth extractions; do not protrude the lower teeth (as in the extraction protocols) and promote the distalization of the upper molars.(Carano; Testa; Siciliani, 1996; Keles; Sayinsu, 2000) These devices use light and continuous forces, are supported on the upper arch, can act by buccal and / or palatal, have an active unit to distalize the molar teeth and another anchoring unit that rests on the first premolars or molars bilaterally.(Hilgers, 1992) Distalizers can also have mucous support on the palate to reinforce anchoring (Nance Button)(Hilgers, 1992; Mavropoulos et al., 2005; Suguino R, 2000). There are several types of distalizer appliaces, such as: Magnets, Pendulum, Pendex, Distal Jet, First Class, etc.(Carano; Testa; Siciliani, 1996; Carriere, 2004; Fortini; Lupoli; Parri, 1999; Gianelly; Bednar; Dietz, 1991; Hilgers, 1992; Jones; White, 1992).

Distalizers proved to be efficient in molar distalization, but they have some side effects, such as loss of 24% to 43% in the anterior anchorage with consequent mesialization and vestibularization of the teeth anterior to the molars.(Bussick; McNamara, 2000; Byloff; Darendeliler, 1997; Hilgers, 1992; Ursi, 2002) In addition, the molar when moving distally tends to rotate and distalize with pendular movement, instead of making a translational movement. (Bussick; McNamara, 2000; Byloff; Darendeliler, 1992; Ursi, 2002) Thinking about minimizing the unwanted effects of molar rotation and angulation, FORTINI, in 1999, developed the First Class appliance; with palatal support, therefore closer to the center of resistance of the molars and with action on the palatal (spring) and buccal (expanding screw) surfaces, which would better control the molar distalization movement.(Fortini; Lupoli; Parri, 1999) However, the loss of anterior anchorage seems to happen in all distalizers.(Bussick; McNamara, 2000; Papadopoulos; Melkos; Athanasiou, 2010; Pinzan-Vercelino et al., 2009)

To minimize the loss of anterior anchorage, distalizer systems based on skeletal anchorage have been proposed, using mainly mini-implants, as they do not require complex surgical procedures and because of the low financial cost, being the most used in clinical routine.(Escobar et al., 2007; Gelgor; Karaman; Buyukyilmaz, 2007; Kinzinger et al., 2008; Oncag et al., 2007) Some studies show that skeletal support cancels the loss of anchorage, and may even promote distalization of the premolars during the distal movement of the molars, possibly due to the effect of stretching the transeptal gingival fibers.(Grec et al., 2013) This effect would contribute to the early dissolution of the previous crowding. (Grec et al., 2013) (Escobar et al., 2007; Kinzinger GS, 2009; Oberti et al., 2009; Oncag et al., 2007; Polat-Ozsoy O, 2008Polat-Ozsoy O, Kircelli BH, Arman-Ozcirpici A, Pektas ZO, Uckan S) However, we must consider that the best distalization effects without loss of anterior anchorage occur when using direct anchorage, that is, supported directly on mini-implants. When the device is also anchored in premolars, we call it indirect anchoring and in these cases there may be a significant loss of anterior anchorage.(Gelgor; Karaman; Buyukyilmaz, 2007; Kinzinger GS, 2009; Oncag et al., 2007)

There is great disagreement among orthodontists on how to treat dental Class II. There are professionals considered to be extractionists and non-extractionists, they opt for superior distalization mechanisms; however, the treatment plan is often based on personal experiences and dogmas.(Ribarevski et al., 1996; Vig et al., 1990) However, orthodontists should prepare their treatment plan based on scientific evidence, taking into account the desired occlusal and aesthetic results for the case. The professional should also have an expectation of the total time that will take the treatment and its final occlusal results, so that it can compare the treatment modalities and choose the most efficient one.

Since the distalizing devices with skeletal anchorage would produce less side effects of loss of anterior anchorage and would not depend on the patient's collaboration in the use of removable anchors, they would theoretically be treated in a shorter period of time.³⁷⁻⁴³ Since Class II treatment with extractions of 2 upper premolars proved to be efficient and as there is no study comparing the efficiency in the treatment of Class II through extractions of 2 upper premolars versus distalization with skeletal anchorage, it would be interesting to compare these two treatment modalities in terms of treatment time and improvement in occlusal indexes.

Regarding orthodontic appointments, about 60 years ago many orthodontists scheduled their patients every 2 weeks, later it was spaced for 3 weeks and currently, most consultations are held from 4 to 6 weeks.(2009; Alger, 1988) The evolution of orthodontic appliances and wires was mainly responsible for this reduction in the number of appointments.(Alger, 1988; Sheridan, 2005) Currently with superelastic

wires, with memory, so many bends and loops used in the past are dispensed with, making treatment simpler, with fewer appointments.(Alger, 1988; Sheridan, 2005) Sheridan (2005), (Sheridan, 2005) suggests that in some cases the patient can be called up every 10 weeks. The author also mentions that in the alignment and leveling phases the appointments can be every 6 to 8 weeks and in the finalization phase of 4 to 5 weeks.(Sheridan, 2005)

En-masse retractions performed with closed springs can close the extraction spaces faster compared to elastic ones; however, the risk of resorption is increased, since it produces continuous force.(Ballard et al., 2009; Weiland, 2003) There seems to be a greater correlation between continuous (and excessive) strength with root resorption.(Ballard et al., 2009; Weiland, 2003) The elastics, on the other hand, suffer progressive loss of strength in the oral environment, which is why it is classified as continuous interrupted force, thus being less harmful. (Weiland, 2003)

As for factors that may influence the treatment time, we must also consider cases that require patient cooperation, such as the use of intermaxillary elastics or headgear since the more spaced the appointments are, the smaller is patient compliance to treatment.(Alger, 1988)

Even with appointments being held up to twice a week, as in the past, it did not appear to produce significant damage to the periodontium or to the roots compared to the present day. Since the elastics for mass retraction significantly lose their strength in the first days of use,(Ash; Nikolai, 1978; Wong, 1976) wouldn't it be interesting to increase the frequency of consultations to change these elastics? Another question: In cases of extraction of 2 maxillary premolars, which often require the collaboration of the patient in the use of headgear or intermaxillary elastic, wouldn't it be advisable to call the patient more often to reinforce the use of these devices? Thinking about that, this study tested se there are difference in Class II treatment efficiency between 2maxillary premolar extraction protocol with appointments once a month or every two weeks.

In addition, this study compared whether there was difference between the degree of efficiency in the orthodontic treatment of Class II malocclusion, a group treated with extractions of 2 upper premolars associated with an edgewise fixed appliance and another group treated primarily with a supported First Class appliance

in MI and later used a fixed edgewise device. In these 2 groups, consultations were monthly. For that, the occlusal results, the treatment time and the efficiency index of these two protocols were compared.

2 ARTICLES
2 ARTICLES

The articles presented in this thesis were written according to the American Journal of Orthodontics and Dentofacial Orthopedics instructions and guidelines for article submission (Annex 2).

Article 1 - Class II malocclusion treatment efficiency with two-maxillary premolar extractions and with the skeletally anchored First Class distalizer

Article 2 - Class II malocclusion treatment with 2-maxillary premolar extractions: monthly versus biweekly appointments, which is more efficient?

2.1 ARTICLE 1

Class II malocclusion treatment efficiency with two-maxillary premolar extractions and with First Class appliance anchored in mini-implants

Abstract:

Introduction: In this study, we compared the efficiency of 2-maxillary-premolarextraction protocol and First Class distalizer with skeletal anchorage in Class II malocclusion treatment. Methods: A sample of 31 patients were divided into 2 groups, Group 1: Treated with extraction of 2 maxillary first premolars; 18 (eighteen) patients (10 male, 08 female) and initial mean age of 14.38 ± 1.38 years. Group 2: Treated with First Class appliance with skeletally anchorage; 13 (thirteen) patients (8 male, 5 female) and initial mean age of 13.38 ± 1.31 years. The Peer Assessment Rating (PAR) occlusal index and the Objective Grading System (OGS) were used based on dental casts to define the treatment time (TT), the percentage of occlusal improvement (PcPRAR, PcOGS) and treatment efficiency (TEI). The TT was calculated and related to the oclusal improvement to determine the TEI. After verifying the normal distribution, the occlusal indexes, TT, and TEI the groups were compared with the *t* test (P<0.05). **Results:** Group 1 had a higher percentage of patients with complete class II than group 2 (66.7% and 15.4% respectively). TT in group 1 was 28.06 months, significantly less than group 2, which was 45.15 months. Group 1 was more efficient (TEI: 3.32) than group 2 (TEI: 1.95). **Conclusions:** Final occlusal results were similar in both groups; however, the TT was significantly shorter in the extractions group, so it was more efficient.

INTRODUCTION

Class II malocclusion in the permanent dentition can be treated with extractions of two maxillary premolars or distalization of the maxillary teeth. Treatment with extractions of 2-premolars have shown good occlusal results, esthetics and reduced treatment times (TT).¹⁻³. The 2-premolar extraction protocol is more efficient, that is, it produces better occlusal results in less TT compared to the treatment with 4 premolar extractions and without extractions.^{2,4} In addition, cases treated with extractions of

premolars have less need for extractions from third molars, unlike cases treated with distalization.^{5,6}

Regarding maxillary distalization, the distalizer appliances are efficient in molar distalization, but its main side effect is the loss of anchorage with consequent mesialization of premolars and proclination of the anterior teeth.^{3,7-10} FORTINI, developed in 1999 the First Class appliance¹¹ with palatal support, thus closer to the molar resistance center and with action on the palatal (spring) and buccal surfaces, which would better control the distal movement of the molars but there was still a loss of anchorage.¹² In order to minimize anterior anchorage loss, distal systems supported by skeletal anchorage have been proposed, using 2 mini-implants (MI), installed on the palate.¹³

Since skeletal anchorage distalizer appliance produce fewer side effects of anterior anchorage loss and would not depend on patient collaboration in the use of removable anchors, they can be treated in a shorter period of time.^{14,15} Treatment of Class II with extractions of 2 upper premolars proved to be efficient³ and as there is no study comparing the efficiency in the treatment of Class II through 2 maxillary premolar extractions versus distalization with skeletal anchorage. The objective of this study is to test the following null hypothesis: There is no difference in Class II treatment efficiency between two-maxillary premolar extraction protocol and the skeletally anchored First Class appliance protocol.

MATERIAL AND METHODS

The research material was used after approval of the study by the Ethics in Research Committee of Bauru Dental School - University of São Paulo, under the protocol number 2.820/2018. The sample was retrospectively selected from the same university. The inclusion criteria consisted on: presence of Class II malocclusion (molar relationship), division 1 and 2; presence of all permanent teeth until the first molars; fixed appliance treatment by Edgewise mechanics; absence of supernumerary tooth, impacted tooth, anomalies in size or form. Cases with previous orthodontic treatment or who had their treatment plan changed during the process were excluded. To make the sample comparable, it was necessary to reduce it; however, the sample size calculation for difference of two means was performed considering the power of the test of 80% and a level of significance of 0.05 in order to detect an intergroup difference of 7.1 months in the variable treatment time with a standard deviation of 6.31 months.²

The minimum number of patients in each group is 13 patients, minimum number reached in the sample. The sample was divided into two groups:

Group 1: 18 (eighteen) patients (10 male, 08 female) treated with extraction of 2 maxillary first premolars and initial mean age of 14.38 ± 1.38 years. Fixed edgewise appliance was used, with 0.022 X 0.028 in conventional brackets. The anterior teeth were retracted en-masse with elastic chains and rectangular wire to correct the overjet. The posterior anchorage was maintained with extraoral headgear and Class II elastics.

Group 2: 13 (thirteen) patients (8 male, 5 female) treated with the First Class appliance with skeletally anchored and initial mean age of 13.38 ± 1.31 years. In group 2, Two self-drilling mini-implants (SIN Implant System®) of 1.6 or 1.8 mm in diameter and 6 or 8 mm in length were installed in each patient, in the anterior palatal region. After the laboratory preparation phase, the First Class appliance was cemented with glass ionomer (Vidrion C - SSWHITE ®) in the molar and premolar bands. To increase the contact of the device with the mini-implant, in order to increase the anchorage, selfcuring acrylic resin was placed in the region of connection of the palatine steel wire with the mini-implants. After the installation of the devices, the procedure for activating the right and left screw, which consisted of 1/4 turn of the day in a counterclockwise direction corresponding to 0.1 mm, was oriented to the patient and / or responsible. Activation was maintained until the patient presented around 1 to 2 mm of overcorrection of the molar relationship (FIGURE 1). Immediately after distalization of the molars, the First Class appliance was removed and a transpalatine bar was installed, also supported in the same mini-implants, in order to keep the molars in the new positions (FIGURE 2). Then, the fixed edgewise appliance was installed, with the same properties as group 1 (FIGURE 3), thus allowing to distalize the other teeth anterior to the molars. When necessary, Class II elastics were used to help obtain a Class I molar relationship.

The patient's chart provided information such as: date of start and end of treatment; initial age; treatment plan and patient cooperation. Pre-and post-treatment dental casts were evaluated, provided the models were in perfect condition.

Peer Assessment Rating index (PAR)

The PAR index was measured from dental casts at the beginning (I-PAR) and at the end of treatment (F-PAR). The PAR consists of the sum of 5 criteria (alignment,

overjet, overbite, midline and posterior occlusion), with their respective weights.¹⁶ The amount of improvement in occlusion (DifPAR) was measured by subtracting the F-PAR from the IPAR and expressed as a percentage of the initial PAR (PcPAR). A high precision caliper was used to make the measurements (FWP, Maub, Polland). We also use PAR to calculate the treatment efficiency index (TEI), using the following equation: TEI = PcPAR / TT, which TEI is directly proportional to PcPAR and inversely proportional TT, that is, the TEI will be greater the greater the positive variation of the

Objective Grading System

PcPAR and the smaller the TT.

Other occlusal index used to evaluate the quality of orthodontics was the Objective Classification System test (OGS), recommended by the American Board of Orthodontics.¹⁷ It is composed of the items: alignment, marginal ridges, buccolingual inclinations, overjet, occlusal contacts, occlusal relationships, interproximal contacts and root parallelism.¹⁷ OGS was used only to compare occlusion at the end of treatment (F-OGS). For the evaluation of models, a metal ruler commercialized by the American Board of Orthodontics (ABO Measurement Meter, St. Louis, USA) was used.

Error study

The I-PAR, F-PAR and OGS scores were recalculated by the same examiner (D.L.T) in the study dental casts of 15 randomly selected patients. The random error was estimated by Dahlberg's formula (Se²= $\sum d^2/2n$), where S² is the error variance and *d* are the difference between 2 determinations of the same variable¹⁸; the systematic errors were calculated with dependent *t* tests at *P*<0.05.

Statistical analyses

Sample normal distribution was assessed and confirmed with Kolmogorov-Smirnov test. Groups comparability regarding the Class II malocclusion severity, type and sex were evaluated with chi-square tests. Comparisons between groups regarding age, PAR, PcPAR, DifPAR, OGS and TEI were performed with t test.

All statistical analyses were performed using Statistica software. (Statistica for Windows, version 7.0, StatSoft Inc., Tulsa, Okla, USA), at *P*<0.05.

RESULTS

The normality of the data was checked using Kolmogorov-Smirnov tests. Since all variables showed normal distribution, parametric tests were used. The PAR and OGS did not have significant systematic errors, and the casual errors were within acceptable levels (Dahlberg: PAR=2.1, OGS=2.5).

The groups were comparable regarding sex, type and severity of Class II malocclusion (Table I). Complete Class II cases were more prevalent in group 1 (66,7%) than in group 1 (15.4%) (Table I).

Although Group 1 had higher I-PAR scores than Group 2 (32,72 and 26,15 respectively) there was no statistical difference (Table II). The results of the final PAR and OGS are shown in table II in which no statistical difference was observed between the groups.

The treatment time of Group 1 was 17.09 months shorter than group 2 (Table III). There was no statistical difference DifPAR and PacPAR. The Treatment efficiency index in Group 1 was significantly greater than in group 2 (Table III).

DISCUSSION

The sample consisted of patients who had bilateral Class II malocclusion and with characteristic of soft tissue profile consistent with maxillary incisor retraction. Thus, compensatory treatment in the maxilla was the treatment of choice for both groups. The objective of the work was to evaluate the occlusal changes related to the treatment time; therefore, discussing the treatment plan, skeletal and esthetic changes were not part of the objectives of the present study. Dental anomalies, history of extractions, previous orthodontic treatment and missing patients were excluded from the sample because they could influence TT and occlusal results. Table I shows a similar distribution in terms of sex and type of Class II, division 1 or 2. These two types of malocclusion tend to have similar occlusal indexes, since the highest scores applied to the overjet, in cases of division 1, are quantitatively compensated by the greater severity of the overbite and crowding present in division 2.¹⁹ As for the severity of the initial Class II, there was a statistical difference between the groups, group 1 presented more cases of complete class II than group 2 (66.7% and 15.4%, respectively) (Table I). However, PAR measured at the beginning of treatment was comparable between the groups, possibly because the other factors such as crowding, overbite and midline have compensated for the higher values of overjet in group 1. All patient information

was acquired from the orthodontic records, so incomplete files and damaged dental casts were discarded. The evaluation of dental casts alone does not provide all the information about the clinical case, being ideal to associate it with imaging tests and clinical examination;^{20,21} however, this is not the objective of the present study. Therefore, dental casts add as much information as necessary to assess occlusal results.²² The PAR index was used at the beginning and end of treatment to quantify the initial class II malocclusion and the results achieved (Table II). OGS was used only at the end of treatment, as recommended by the American Board of Orthodontics (ABO).¹⁷ These two indices were chosen for their reliability, reproducibility and objectivity in measurement.^{16,17,23}

The results showed no statistical difference between the F-PAR and the OGS measured at the end of the treatment, showing that the two treatment methods produce similar occlusal results (Table II). The fact that Group 1 finalizes the occlusion of the molars in Class II does not decrease the score "posterior occlusion" in the PAR, as this quantifies the same score if the molar is in class I or complete Class II. Richmond²³ considers F-FAR less or equal than 5 to be "almost perfect" and both groups had F-PAR averages within this requirement. The final results of the OGS were also similar between groups. Despite ABO suggesting final values below 30, group 1 and Group 2 showed values above the recommended (38.16 and 31.84, respectively). A plausible explanation is that the OGS is extremely thorough with orthodontic completion and all patients in the sample were treated by students of orthodontics, who do not have the same level of accuracy as experienced orthodontists and that ABO intends to select.

The results of DifPAR and PcPAR also showed similarity between the groups. DifPAR shows us quantitatively the reduction of PAR with treatment, however with PcPAR the orthodontist can more clearly visualize the percentage improvement of F-PAR compared to I-PAR and the two groups had an improvement above 84% (Table III).

In addition, there was a significant difference in TT, in which the group treated with extractions (group 1) was 17.09 months faster than group 2. One of the probable causes of TT in group 2 was elevated would be that the treatment is divided into two stages, one of distalization of the molars and another for distalization of premolars and retraction of anterior teeth whereas in group 1 this division does not exist. Studies show that mini-implants do not remain completely immobile in the bone when subjected to orthodontic forces, so this would contribute to the loss of anchorage.^{24,25} Another

possible cause of the loss of previous anchorage would be the type of fitting of the MI with the First Class being semi-rigid with the use of acrylic resin, similar to another study that observed a similar loss of anchorage.^{14,26} Studies show that when anchorage is direct (distalizer device supported only on MI) there is no loss of anterior anchorage, unlike the present study that used indirect anchorage, also supported on the first premolars; but when the anchorage is indirect, there is a reaction force in the supporting teeth with consequent mesialization.^{14,26,27} Due to the loss of anchorage, after the first phase of molar distalization, TT is increased to retract premolars and anterior teeth to occlude in Class I. The simplicity of the technique used in group 1, with sliding mechanics, compared to group 2 may also have contributed to the TT.

Several studies state that tooth extractions increase TT, but these studies usually do not take into account the initial severity of malocclusion or make no distinction between Class II and Class I malocclusion.^{28,29 30} On the other hand, other studies have shown that carrying out premolar extractions to treat Class II malocclusion is faster than without extractions,² when compared to the pendulum appliance,³ or versus 4 premolar extractions.¹⁹ Regarding the TEI, as the percentage of reduction in the PAR index was similar between groups, the only factor that could influence efficiency would be the TT; Thus, group 1, treated with extractions, proved to be more efficient, statistically significant (Table III).

CONCLUSIONS

According to the results, the null hypothesis was rejected because:

- The occlusal results were similar in both groups;
- However, the treatment time was significantly shorter in the extractions group, so it was more efficient;
- Although the initial severity of Class II was higher in group 2, the treatment time was shorter, proving its efficiency.

FIGURE LEGENDS

Fig. 1: End of the molar distalization phase with the First Class appliance anchored in 2 mini-implants.

Fig. 2: A transpalatal bar was installed, also supported in the same mini-implants.

Fig. 3: The fixed edgewise appliance was installed, with the same properties as group 1.



Fig. 2





Fig. 3

Table I. Results of intergroup comparability of the sex, Class II severity and type. (Chi-square tests).

Variables		Group 1 Group 2 (2PM Extrac) (F.Class+MI)		Significance
	Females	8	5	_
Sov		44.4%	38.5%	0 720
Sex	Males	10	8	0.759
		55.6%	61.5%	-
	¼ Class II	0	1	
		0.0%	7.7%	-
	1/2 Class II	2	6	-
Class II		11.1%	46.2%	0.016*
Severity	³ ∕₄ Class II	4	4	0.010
		22.2%	30.8%	-
	Complete	12	2	-
	Class II	66.7%	15.4%	-
	Division 1	15	11	
Class II		83.3%	84.6%	0.004
Туре	Division 2	3	2	0.924
-		16.7%	15.4%	-

Variables –	Group 1 (2PM Extrac)		Grou (F.Clas	p 2 s+MI)	Significance
	Mean	SD	Mean	SD	Р
Initial Age	14.38	1.38	13.38	1.31	0.142
I-PAR	32.72	7.85	26.15	15.41	0.131
F-PAR	5.00	3.53	3.23	2.83	0.157
OGS	38.17	11.00	31.85	9.02	0.100

Table II. Results of compatibility between groups for initial age and initial PAR index (T tests). The results of the final PAR and OGS.

Variables	Group 1 (2PM Extrac)		Grou (F.Clas	ıp 2 s+MI)	Significance
	Mean	SD	Mean	SD	F
Treatment Time (months)	28.06	7.51	45.15	7.87	<0.001*
DifPAR (n)	27.72	7.39	22.92	15.19	0.253
PcPAR (%)	84.74	10.84	86.08	12.34	0.751
TEI (Efficiency)	3.23	1.018	1.95	0.41	<0.001*

Table III. Results of intergroup comparison of Treatment time, DifPAR, PacPAR and TEI (T tests).

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2.2 ARTICLE 2

Class II malocclusion treatment with 2-maxillary premolar extractions: monthly versus biweekly appointments, which is more efficient?

ABSTRACT

Introduction: In patients with Class II malocclusion treated with 2-premolar extractions, this study compared whether there is difference in treatment time (TT) and efficiency when appointments are held once a month or at two-week intervals. Methods: These patients were treated with the same orthodontic mechanics and divided into 2 groups, according to frequencies of orthodontic appointments; Group 1: 18 (eighteen) patients (10 male, 08 female), initial mean age of 14.38 ± 1.38 years and appointments once a month. Group 2: 19 (nineteen) patients (9 male, 10 female), initial mean age of 14.12 ± 1.38 years and appointments biweekly. Edgewise fixed device was used and the anterior teeth were retracted en-masse with a rectangular wire and elastic chains. From the dental casts, the Peer Assessment Rating (PAR) and Objective Grading System (OGS) indices were measured at the beginning and at the end of the treatment. Efficiency was assessed by dividing the percentage of improvement of each occlusal index in relation to the multiplication of TT and number of appointments (NA). Results: The two groups were similar in PAR and OGS measured at the end of treatment. Group 1 and group 2 presented significantly different TT (28.06 and 22.05 months, respectively). There was no difference in the efficiency indices. **Conclusion:** Class II malocclusion patients treated with 2-maxillary premolars had significantly smaller treatment time when seen on biweekly appointments than those seen on monthly appointment; however, there was no difference in efficiency.

INTRODUCTION

Having an estimate of the total treatment time and whether the treatment will be efficient is essential, both from a clinical point of view and from the perspective of financial costs involved in the treatment. In the 60s, many orthodontists scheduled their patients every 2 weeks, later it was spaced for 3 weeks and currently, most consultations are held from 4 to 6 weeks.^{1,2} Mainly with the evolution of orthodontic wires, superelastic wires started to be used routinely in the clinic, which reduced the

complexity of the treatment with less use of bends and loops in the traditionally used wires, thus reducing the number and clinical time of the appointments.^{1,3}

There is little scientific evidence relating damage to the periodontium or risk of root resorption with the frequency of activation of the orthodontic appliance.⁴ What has been proven is that continuous forces offer a greater risk to dentin resorption, that is, in the case of en-masse retractions, the forces produced by closed springs would be more harmful than the use of elastics.^{5,6} In addition, histological studies report that the cementum needs 2 to 3 weeks to recover in hyalinized areas.⁷ Knowing that, even with weekly consultations,^{8,9} no significant problems with loss of periodontal support or significant resorption were reported; that the elastics lose their force significantly in the first days of use ^{10,11} and that currently, patients have been treated with large intervals of time and obtaining satisfactory results.¹ The present study aimed to compare TT and treatment efficiency index (TEI) between two groups, one attended every 2 weeks and the other once a month (4-5 weeks). The patients presented Class II malocclusion, which was treated with extraction of two maxillary premolars and with sliding mechanics, with elastic chain. This study tested the following null hypothesis: There is no difference in Class II treatment time and efficiency between 2-maxillary premolar extraction protocol with appointments once a month or every two weeks.

MATHERIAL AND METHODS

This study was approved by the Ethics in Research Committee of Bauru Dental School, University of São Paulo, Brazil (2.820/2018). The sample was collected from the archive at this same university and it was a retrospective study. Using an alpha error of 5% and a beta error of 20%, considering a standard deviation of 6.31,¹² to detect a minimum difference of 6.0 months for TT, indicated that a minimum of 36 patients were necessary. We managed to select 37 patients. The inclusion criteria consisted on: presence of Class II malocclusion division 1 and 2; presence of all permanent teeth until the first molars, absence of dental anomaly in number or form and without previous history of orthodontic treatment. These patients were divided into 2 groups, according to frequencies of orthodontic appointments:

Group 1: 18 (eighteen) patients (10 male, 08 female). Initial mean age of 14.38 ± 1.38 years. Appointments once a month.

Group 2: 19 (nineteen) patients (9 male, 10 female). Initial mean age of 14.12 ± 1.38 years. Appointments biweekly.

Fixed Edgewise appliance, with 0.022 x 0.028-inch conventional brackets was used in all patients. In most patients the following sequence of wires was used: initially, 0.015-in Twist-Flex or a 0.016-in Nitinol, followed by 0.016, 0.018, 0.020, and 0.021X0.025 or 0.018X0.025-in stainless steel wires.

When necessary, extraoral headgear and intermaxillary elastics were used as anchorage and to finish the treatment with Class II molars and Class I canines. Deepbite was corrected with accentuated and reverse curve of Spee. The anterior teeth were retracted en-masse with a rectangular wire and elastic chains. Extraoral headgear appliance was used to reinforce anchorage and maintain the Class II molar relationship.

The patient's charts were used to obtain initial age and sex of the patients. The initial therapeutic plan of each patient was consulted regarding the proposed treatment protocol. The records of therapeutic procedures were evaluated regarding the start and end dates of treatment, frequency and number of appointments. The final treatment report was evaluated for compliance with initial planning and patient cooperation. Records and the initial and final dental study models of patients who initially had Class II malocclusion (molar relationship) and that fit the inclusion criteria of the present study. Damaged dental casts were excluded from the sample.

Occlusal Indexes

The Peer Assessment Rating (PAR) index was measured according DeGuzman et al. ¹³. The 5 criteria that comprise it were used: alignment, overjet, overbite, midline and posterior occlusion, measured at the beginning (I-PAR) and at the end of the treatment (F-PAR). Subtracting the F-PAR value from the I-PAR, we abstained from the improvement value of the occlusion that we called DifPAR. This variation in the occlusal index expressed as a percentage is called PcPAR. All initial and final dental casts were measured, totaling 74 pairs of models. We used a caliper (FWP, Maub, Polland) capable of printing the measurements performed accurate up to 0.1mm.

The American Board of Orthodontics (ABO) recommends using the Objective Grading System (OGS) to measure the quality of treatment completion.¹⁴ The OGS use 7 criteria measured on dental casts: alignment, marginal ridges, buccolingual inclinations, overjet, occlusal contacts, occlusal relationships, interproximal contacts and 1 measured in panoramic radiograph, the root angulation.¹⁴ For the evaluation of casts, we used a metal ruler recomended by the ABO (ABO Measurement Meter, St.

Louis, USA).¹⁴ OGS was also measured at the beginning (I-OGS) and at the end of treatment (F-OGS); as well as its variation, DifOGS and PcOGS.To measure treatment efficiency (TEI), we use the following formula:

TEI = PcPAR / TTxNumber of Appointments (NA). In this way, we were able to evaluate the three fundamental variables for TEI, which is directly proportional to PcPAR and inversely proportional to TT and NA.

Error study

The same examiner reevaluated the PAR and OGS indices after 30 days, using dental casts of 15 randomly selected patients. The systematic errors were calculated with dependent *t* tests at P < .05 and the random errors were estimated by Dahlberg's formula.¹⁶

Statistical analyses

Sample normal distribution was assessed with Kolmogorov-Smirnov tests.

Groups comparability regarding the Class II malocclusion severity and sex were evaluated with chi-square tests. Comparisons between groups regarding age, I-PAR, F-PAR, DifPAR, PcPAR, TeiPAR, I-OGS, F-OGS, DifOGS, PcOGS and TeiOGS were performed with *t* test. All statistical analyses were performed with Statistica software (Statistica for Windows, version 7.0, StatSoft Inc., Tulsa, Okla, USA), at *P*<0.05.

RESULTS

There was no statistically significant systematic error and the random errors were within acceptable limits, on measuring PAR and OGS indexes (Table I). The table II show that there was no statistical difference between the groups regarding sex, type and severity of Class II malocclusion. Results regarding Initial Age compatibility, I-OGS and I-PAR are shown in table III. There was no statistical difference between these variables, showing that the selection criteria was sufficient to make the groups comparable. In addition, the F-PAR and F-OGS results were also similar, with no statistical difference between the groups (Table III).

The table IV evidence that TT of Group 1 was 6.01 months longer than group 2 (28.06 and 22.05 months, respectively). There was no statistically significant difference neither for the PAR change (Dif-PAR) nor for the percentage of PAR reduction (PcPAR) between groups. Occlusal changes were also similar in the DifOGS and

PcOGS (Table IV). The efficiency, TeiPAR and TeiOGS was similar in both groups (Table IV).

DISCUSSION

The sample consisted of patients with Class II, divisions 1 and 2 malocclusion and degrees of severity ¹/₂, ³/₄ and complete. Class II cases occur without planned extractions, but due to the patient's lack of collaboration, they end up being redesigned, with an indication of extractions of two maxillary premolars; however, cases like this were not included in the sample so as not to create a bias in the TT. Therefore, all patients in the sample extracted two maxillary premolars in the first months of treatment. We tried to make the sample quite homogeneous, with no statistical difference as to sex, type and severity of Class II malocclusion and initial age (Table II and II). Most patients (75.7%) had complete Class II at the beginning of treatment, justifying studies that report that the majority of patients treated with extractions have greater severity of class II malocclusion.¹⁷⁻¹⁹ The PAR and OGS index were measured using dental casts, which should be in good condition. Cases with damaged dental casts were excluded from the sample. We chose to use these two indices for the reliability and reproducibility of both methods.¹³⁻¹⁵

The results I-PAR and I-OGS showed comparability, with minimal difference between groups. The OGS was conceived by ABO to be used only at the end of orthodontic treatment, to measure the refinement of orthodontists who intend to be part of the group of the Board of Orthodontics.¹⁴ However, we chose to use it also at the beginning of the treatment (I-OGS), because we think it would provide important information when relating to the F-OGS. Table III shows that the results of PAR and OGS were very similar at the beginning and at the end of the treatment, with no statistical difference between the groups, so the groups were comparable at the beginning of the treatment and had a very similar orthodontic completion as well. Both PAR and OGS score points as malocclusion increases, so the closer to zero the index is, the greater the perfection of the occlusion. Richmond¹⁵ and Buchanan²⁰ suggest ending the treatment with the PAR with a value equal to or less than 5 (five) to be considered "almost perfect", and values between 5 (five) and 10 (ten) adjectivate as "reasonable". Group 1 presented 5.00 as F-PAR value and 6.31 as group 2. (Table III) Despite having different values, this difference was not statistically significant.

Unlike PAR, the OGS scores deviations greater than 0.5mm and evaluates questions such as: marginal ridges level, buccolingual inclination, and root angulation, this measured on the panoramic radiograph.¹⁴ The ABO recommends orthodontists to finish treatments with scores up to 30 points;¹⁴ however, the results of the OGS were 38,16 for group 1 and 37,68 for group 2. (Table III) The fact that the patients were treated by students of orthodontics, with little clinical experience, is the probable explanation for the scores having greater than that recommended by ABO.

When assessing the occlusal improvement at the end of the treatment compared to the beginning, we noticed that there was a similar variation between the groups both in the PAR and in the OGS. (Table IV) The numerical difference of the PAR (DifPAR) and the percentage (PcPAR) was important, with an improvement of around 80% in the index. The change in OGS was smaller, with an improvement of 51.51% in group 1 and 53.57% in group 2. (Table IV) Again, because OGS is more rigorous than PAR, the values of F-OGS were higher, influencing the DifOGS and PcOGS variables.

Table IV also shows that the difference in TT between the groups was statistically significant. Group 1 showed a TT of 28.06 months, while group 2 took 22.05 months. The difference between the groups was 6.01 months. All patients underwent extraction of two maxillary premolars and en-masse retraction of the anterior teeth, using elastic chains. The use of elastic provides greater control in the closure of extraction spaces and the type of force is continuous interrupted, with less risk of root resorption.^{5,6} On the other hand, the elastic loses force around 75% of the first 24 hours¹⁰ and loses the rest of the strength up to 21 days,¹¹ thus requiring regular changes. Although there are many histological studies on ideal force in tooth movement,^{7,21,22} there is no consensus on the frequency that we should use force in the periodontium. Most authors recommend a minimum interval of 3 weeks between appointments.^{3,23} Alger et al, 1988,¹ for example, recommend for cases of extractions, appointments every 4 weeks and intervals over 6 weeks in other cases.

The orthodontist should ask himself if it pays to call the patient biweekly, with a consequent increase in operating costs for the professional and a greater number of absences from work or school by the patient, to "shorten" around six months of treatment. The equations used to evaluate the efficiency of the TEI treatment took into account the number of appointments, the percentage of reduction in the occlusal index and the TT (Table IV). There was no statistical difference between the groups. Most

patients used extraoral anchorage to reinforce the posterior anchorage and Class II elastic for completion.¹² It is known that, when there is a long interval between appointments, the patient tends to collaborate less with the use of elastic and extraoral anchorage.³ Possibly the patients in Group 2 collaborated, as they were reinforced to use extraoral anchorage and elastics more frequently, thus contributing to speed up treatment. Since group 1 used more twist-flex wires, instead of Nitinol, perhaps the time duration of the alignment, leveling and space closing phases were significantly different between the groups, however these data were not possible to acquire from clinical records.

CONCLUSIONS

According to these results, the null hypothesis was rejected because:

- Treatment time was shorter in the group seen on a biweekly frequency;
- There was no difference in the final occlusal results;
- However, there was no intergroup difference regarding treatment efficiency.

Variables	1st Measurement (N=15)		2nd Measurement (N=15)		Р	Dahlberg
	Mean	SD	Mean	SD		
PAR	16.3	14.0	16.2	12.8	0.904	2.1
OGS	57.0	23.3	57.2	21.9	0.840	2.5

Table I. Results of the error study (Dahlberg's formula – random errors and dependentt tests – systematic errors)

Variables		G1 (Monthly) N=18	G2(Biweekly) N=19	Significance
	Fomoloo	8	10	
Car	Females	44.4%	52.6%	0.746
Sex	Malaa	10	9	0,740
	wates	55.6%	47.4%	
	1/2 Class II	2	2	
		11.1%	10.5%	
Coverity	³ ⁄ ₄ Class II	4	1	0.251
Severity		22.2%	5.3%	0,351
-	Complete	12	16	
	Class II	66.7%	84.2%	
Type of Class II	Division 1 –	15	12	
		83.3%	63.2%	0.000
	Division 2 -	3	7	0,269
		16.7%	36.8%	

Table II. Results of intergroup comparability of the sex, Class II severity and type. (Chi-square tests).

Variables	G1 (Monthly) N= 18		G2 (biv N=	veekly) 19	Significance
	Mean	SD	Mean	SD	
Age	14.38	1.38	14.12	1.38	0.570
I-PAR	32.72	7.85	32.42	9.08	0.915
F-PAR	5.00	3.53	6.31	3.63	0.272
I-OGS	80.50	13.67	82.89	12.42	0.580
F-OGS	38.16	10.99	37.68	10.99	0.884

Table III. Results regarding age, PAR and OGS index (T-tests)

Variables	G1(Monthly) N=18		G2 (Biv N=	Significance	
	Mean	SD	Mean	SD	
Treatment Time (Month)	28.06	7.51	22.05	5.86	0.010*
DifPAR (n)	27.72	7.39	26.11	8.89	0.553
PcPAR (%)	84.74	10.84	79.87	12.29	0.211
PcOGS (%)	51.51	15.21	53.57	13.25	0.664
DifOGS	42.33	16.77	45.21	15.67	0.593
TEIPAR	0.114	0.057	0.11	0.05	0.079
TEIOGS	0.06	0.035	0.07	0.04	0.052

Table IV. Results of treatment time, Variations in even PAR and OGS indices and TEI (T-tests)

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3 DISCUSSION
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Compensatory treatment in the maxilla was the treatment of choice for all groups, because patients had Class II malocclusion and characteristics that allowed the retrusion of the upper incisors without negatively compromising the facial profile. Kessel, in 1963,(Kessel, 1963) indicated extractions of two maxillary premolars in patients older than 12 years of age, whose growth potential tends to decrease progressively. Maxillary distalizers are also indicated when the problem is dentoalveolar.(Fortini; Lupoli; Parri, 1999; Hilgers, 1992) The objective of the work was to evaluate the occlusal changes related to the treatment time; therefore, discussing the treatment plan, skeletal and aesthetic changes were not part of the objectives of the present study. Dental anomalies, history of extractions, previous orthodontic treatment or who had their treatment plan changed during the process were excluded from the sample because they could influence TT.

The sample had similar distribution in terms of sex and type of Class II, division 1 or 2. It is important for groups to be compatible with respect to sex, as sexual dimorphism can influence skeletal growth, especially in the mandible.(Bishara; Peterson; Bishara, 1984) The two types of Class II malocclusion, division 1 and 2 were also homogeneous, however they tend to have similar occlusal indexes, since the highest scores applied to the overjet, in cases of division 1, are quantitatively compensated by the greater severity of the overbite and crowding present in division 2.(Janson et al., 2004) As for the severity of the initial class II, there was a statistical difference between the groups; the extraction group (monthly) presented more cases of complete class II than FCMI (66.7% and 15.4%, respectively). However, PAR measured at the beginning of treatment was compatible between the groups, possibly because the other factors such as crowding, overbite and midline have compensated for the higher values of overjet in extraction group. When evaluating the cases of extraction of 2 maxillary premolars, monthly versus biweekly, we observed that there was no statistical difference regarding the initial severity of Class II malocclusion and most cases presented complete class II (molar relationship), justifying studies that report that the majority of patients treated with extractions have greater severity of class II malocclusion.(Robb et al., 1998; Turbill; Richmond; Wright, 2001; Vig et al., 1998)

All patient information was acquired from the orthodontic documentation, so incomplete files and damaged dental casts were discarded. The evaluation of dental casts alone does not provide all the information about the clinical case, being ideal to associate it with imaging tests and clinical examination;(Keeling et al., 1989; Pancherz; Zieber; Hoyer, 1997) however, this is not the objective of the present study. Therefore, dental casts add as much information as necessary to assess occlusal results.(Han et al., 1991) The PAR index was used at the beginning and end of treatment to quantify the initial class II malocclusion and the results achieved. OGS was used only at the end of treatment, as recommended by the American Board of Orthodontics (ABO).(Casko et al., 1998) However, we chose to use it also at the beginning of the treatment, because we think it would provide important information when relating to the final OGS. These two indices were chosen for their reliability, reproducibility and objectivity in measurement.(Casko et al., 1998; DeGuzman et al., 1995; Richmond et al., 1992)

The results showed no statistical difference between the PAR and the OGS measured at the end of the treatment, showing that the all treatment methods produce similar occlusal results. The fact that the cases of 2-premolar extraction finalizes the occlusion of the molars in class II does not decrease the score "posterior occlusion" in the PAR, as this quantifies the same score if the molar is in class I or complete Class II.(Richmond et al., 1992) There was also no statistical difference between the groups regarding the OGS measured at the end of treatment. Despite ABO suggesting final values below 30, all groups showed values slightly above the recommended A plausible explanation is that the OGS is extremely thorough with orthodontic completion and all patients in the sample were treated by students of orthodontics, who do not have the same level of accuracy as experienced orthodontists and that ABO intends to select.

The results of DifPAR and PcPAR also showed similarity between the groups. DifPAR shows us quantitatively the reduction of PAR with treatment, however with PcPAR the orthodontist can more clearly visualize the percentage improvement of F-PAR compared to I-PAR and the all groups had an improvement above 79%.

There was a significant difference in TT, in which the group treated with extractions (monthly) was 17.09 months faster than FCMI. One of the probable causes would be that the treatment using FCMI is divided into two stages, one of distalization of the molars and another for distalization of premolars and retraction of anterior thus increasing the TT. Studies show that mini-implants do not remain completely immobile in the bone when subjected to orthodontic forces, so this would contribute to the loss of anchorage.(Kinzinger et al., 2008; Liou; Pai; Lin, 2004) Another possible cause of the loss of previous anchorage would be the type of fitting of the mini-implants with the First Class being semi-rigid with the use of acrylic resin, similar to another study that observed a similar loss of anchorage.(Gelgor; Karaman; Buyukyilmaz, 2007; Grec et al., 2013) Studies show that when anchorage is direct (distalizer device supported only on MI) there is no loss of anterior anchorage, unlike the present study that used indirect anchorage, also supported on the first premolars; but when the anchorage is indirect, there is a reaction force in the supporting teeth with consequent mesialization. (Gelgor; Karaman; Buyukyilmaz, 2007; Grec et al., 2013; Polat-Ozsoy O, 2008Polat-Ozsoy O, Kircelli BH, Arman-Ozcirpici A, Pektas ZO, Uckan S) Due to the loss of anchorage, after the first phase of molar distalization o TT is increased to retract premolars and anterior teeth to occlude in class I. The simplicity of the technique used in group 2, with sliding mechanics, compared to group 1 may also have contributed to the TT.

When comparing the groups that performed extractions, the monthly group showed a TT of 28.06 months, while biweekly group took 22.05 months. The difference between the groups was 6.01 months, statistically significant. All patients underwent extraction of two maxillary premolars and en-masse retraction of the anterior teeth, using elastic chains. The use of elastic provides greater control in the closure of extraction spaces and the type of force is continuous interrupted, with less risk of root resorption.(Ballard et al., 2009; Weiland, 2003) On the other hand, the elastic loses force around 75% of the first 24 hours(Ash; Nikolai, 1978) and loses the rest of the strength up to 21 days, (Wong, 1976) thus requiring regular changes. Although there are many histological studies on ideal force in tooth movement, (Hellsing; Hammarstrom, 1996; King; Fischlschweiger, 1982; Roberts; Goodwin; Heiner, 1981) there is no consensus on the frequency that we should use force in the periodontium. Most authors recommend а minimum interval of 3 weeks between appointments.(Proffit, 2018; Sheridan, 2005) Alger et al (1988),(Alger, 1988) for example, recommend for cases of extractions, appointments every 4 weeks and intervals over 6 weeks in other cases. The orthodontist should ask himself if it pays to call the patient biweekly, with a consequent increase in operating costs for the professional and a greater number of absences from work or school by the patient, to "shorten" around six months of treatment.

Several studies say that tooth extractions increase TT, but these studies usually do not take into account the initial severity of malocclusion or make no distinction between Class II and Class I malocclusion.(O'Brien et al., 1995; Vig et al., 1998) (Holman et al., 1998) On the other hand, other studies have shown that carrying out premolar extractions to treat class II malocclusion is faster than without extractions,(Janson et al., 2007a) when compared to the pendulum appliance,(Pinzan-Vercelino et al., 2009) or versus 4 pre molar extractions.(Janson et al., 2004) Regarding the treatment efficiency (TEI), the extraction group (monthly), proved to be more efficient, statistically significant.

When comparing extraction groups (monthly versus biweekly), the equations used to evaluate the efficiency of the TEI treatment took into account the number of appointments, the percentage of reduction in the occlusal index and the TT. There was no statistical difference between the groups although the TT was higher in the treated group once a month. The longer treatment time in the group called monthly was offset by the greater number of appointments in the group called every two weeks, so there was no difference between them as to the treatment efficiency index.

Most patients used headgear to reinforce the posterior anchorage and Class II elastic for orthodontic finalization.(Janson et al., 2007a) It is known that, when there is a long interval between appointments, the patient tends to collaborate less with the use of elastic and headgear.(Sheridan, 2005) Possibly the patients called every two weeks collaborated more, as they were reinforced to use headgear and elastics more frequently, thus contributing to speed up treatment. Since biweekly group used more twist-flex yarns, instead of Nitinol, perhaps the time duration of the alignment, leveling and space closing phases were significantly different between the groups, however these data were not possible to acquire from clinical records.

4 FINAL CONSIDERATIONS

4 FINAL CONSIDERATIONS

When we compared the treated group with extractions of 2 maxillary premolars (appointments once a month) versus FCMI, the treatment time was significantly shorter in the extractions group, so it was more efficient. Although the initial severity of Class II was higher in extraction group, the treatment time was shorter, proving its efficiency.

Comparing the groups that made extractions, regarding the frequency of consultations, we see que o treatment time was shorter in the group seen on a biweekly frequency; however, there was no intergroup difference regarding treatment efficiency.

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APPENDICES

DECLARATION OF EXCLUSIVE USE OF THE ARTICLE IN THESIS

We hereby declare that we are aware of the article "Class II malocclusion treatment with 2-maxillary premolar extractions: monthly versus biweekly appointments, which is more efficient?" will be included in thesis of the graduate student Diego Luiz Tonello and may not be used in other works of Graduate Programs at the Bauru Dental School, University of São Paulo.

Bauru, March 03th of 2020.

Diego Luiz Tonello

Dr. Guilherme Janson

Dr. Daniela Garib



DECLARATION OF EXCLUSIVE USE OF THE ARTICLE IN THESIS

We hereby declare that we are aware of the article "Class II malocclusion treatment efficiency with two-Maxillary premolar extractions And With First Class appliance anchored in mini-implants" will be included in thesis of the graduate student Diego Luiz Tonello and may not be used in other works of Graduate Programs at the Bauru Dental School, University of São Paulo.

Bauru, March 03th of 2020.

Diego Luiz Tonello

Dr. Guilherme Janson

Dr. Daniela Garib

ANNEX

ANNEX 1

USP - FACULDADE DE ODONTOLOGIA DE BAURU DA

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Título. Eficiência do tratamento da má oclusão de Classe II com extrações de dois prémolares superiores e com o aparelho First Class ancorado em miniimplantes

Pesquisador: Diego Luiz Tonello Área Temática: Versão: 1 CAAE: 94434618.3.0000.5417 Instituição Proponente: Universidade de São Paulo - Faculdade de Odontologia de Bauru Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 2.820.972

Apresentação do Projeto:

Este estudo irá comparar a eficiência do protocolo de extrações de 2 pré-molares superiores e o aparelho distalizador First Class ancorado em mini-implantes no tratamento da má oclusão de Classe II. A amostra será composta pela análise de modelos de 50 pacientes com má oclusão de Classe II e será dividido em 2 grupos com as seguintes características: grupo 1: 30 pacientes já tratados com extrações de 2 pré-molares superiores com média de idade inicial de 13.91 anos, e grupo 2: composto por 20 pacientes com média de idade inicial de 13.28 anos, já tratados com o distalizador First Class com ancoragem esquelética apoiado em 2 mini-implantes instalados no palato.

Objetivo da Pesquisa:

O objetivo do estudo será comparar a eficiência de dois protocolos de tratamento na má oclusão de classe II. Um protocolo com extrações de dois prémolares superiores e outro sem extrações e com distalização dentária superior usando-se aparelho apoiado em ancoragem esquelética.

Avaliação dos Riscos e Benefícios:

Descritos adequadamente.

Comentários e Considerações sobre a Pesquisa:

Projeto está bem descrito e parece trazer contribuições interessantes.

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Considerações sobre os Termos de apresentação obrigatória:

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Orçamento	Orcamento.pdf	25/07/2018 21:11:39	Diego Luiz Tonello	Aceito
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Declaração de Instituição e Infraestrutura	3termo_aquiescencia.pdf	25/07/2018 21:04:27	Diego Luiz Tonello	Aceito
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TCLE / Termos de Assentimento / Justificativa de Ausência	Dispensa_TCLE.pdf	25/07/2018 20:54:16	Diego Luiz Tonello	Aceito

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Declaração de Pesquisadores	DeclaracaoCompromissoPesquisadorRe sultadosPesquisa.pdf	25/07/2018 20:53:19	Diego Luiz Tonello	Aceito
Projeto Detalhado / Brochura Investigador	Proj_PesquisaCEP2018.pdf	25/07/2018 20:51:19	Diego Luiz Tonello	Aceito
Outros	QuestionarioTecnicoPesquisador.pdf	25/07/2018 20:49:52	Diego Luiz Tonello	Aceito
Folha de Rosto	folha de rosto Diego.pdf	25/07/2018 20:39:49	Diego Luiz Tonello	Aceito

Situação do Parecer: Aprovado

Necessita Apreciação da CONEP: Não

BAURU, 14 de Agosto de 2018

Assinado por: Ana Lúcia Pompéla Fraga de Almeida (Coordenador)

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ANNEX 2



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Official Journal of the American Association of Orthodontists, its constituent societies, the American Board of Orthodontics, and the College of Diplomates of the American Board of Orthodontics

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- Abstracting and Indexing
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DESCRIPTION

Published for more than 100 years, the American Journal of Orthodontics and Dentofacial Orthopedics remains the leading **orthodontic** resource. It is the official publication of the American Association of Orthodontists, its constituent societies, the American Board of Orthodontics and the College of Diplomates of the American Board of Orthodontics. Each month its readers have access to original peer-reviewed articles that examine all phases of **orthodontic treatment**. Illustrated throughout, the publication includes tables, photos (many in full color), and statistical data. Coverage includes successful diagnostic procedures, imaging techniques, bracket and archwire materials, extraction and impaction concerns, orthognathic surgery, TMJ disorders, removable appliances, and adult therapy.

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