UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

MARCELO SOARES CORRÊA

Comparison of smile attractiveness, dental inclination, and dental arch widths in patients treated with Damon system self-ligating appliance, using two different bonding: conventional and “Smile Arc”

Comparação da atratividade do sorriso, inclinações dentarias e dimensões dos arcos dentários em pacientes tratados com aparelho autoligável, no sistema Damon, usando dois diferentes tipos de colagem: convencional e “Smile Arc”

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Tese constituída por artigos apresentada à Faculdade de Odontologia de Bauru da Universidade de São Paulo para obtenção do título de Doutor em Ciências no Programa de Ciências Odontológicas Aplicadas, na área de concentração Ortodontia.

Orientador: Prof. Dr. Marcos Roberto de Freitas

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ABSTRACT

Comparison of smile attractiveness, dental inclination, and dental arch widths in patients treated with Damon system self-ligating appliance, using two different bonding: conventional and "Smile Arc"

Objective: The purpose of this retrospective study was to evaluate whether there is a difference in the smile attractiveness, dental inclinations and dental arches dimensions in patients treated by the Damon® System, using two different orthodontic bonding: conventional and "Smile Arc Protection". **Material and methods:** The sample consisted of 40 patients (19 women, 21 men) with completed orthodontic treatment who already have all the initial and final documentation, including cone beam computed tomography (CBCT). The sample was divided into two groups: group 1 - 20 patients, 7 women and 13 men, with initial age mean of 23,75 ± 4,03 and final age mean 26,87 ± 4,09, treated with Damon system using conventional bonding; group 2 - 20 patients, 12 women and 8 men, with initial age mean of 28,11 ± 9,66 and final age mean 30,62 ± 10,46, treated with Damon system using "Smile Arc" bonding. Eighty CBCT images, 40 pretreatment and 40 posttreatments were evaluated. Initials and finals dental inclinations, and dental arches dimensions were evaluated, and compared between these two groups. Eighty frontal photographs of the posed smile, 40 pretreatment (T1) and 40 posttreatment (T2) photographs were evaluated to compare the smile attractiveness between the two groups, and compared between these two groups. A website with the smile attractiveness evaluation instructions was created for the raters. Through e-mail, each possible evaluator received a link to the evaluations form. The smiles were automatically randomized, each time the user accessed the webpage. The groups of evaluators consisted of 3 groups: group 1 - 59 orthodontists, group 2 - 62 dentists and group 3- 57 lay people with a mean age of 39.83 (±10.48), 48.73 (±14.07) and 42.68 (±14.03) respectively. **Results:** The intergroup comparison of the dental inclination at the initial stage (T1), the conventional group was presenting statistically significantly greater dental inclination than the smiler arc group, and the smile arc group showed a smaller arch width than the conventional group. In the final stage (T2), after the end of orthodontic treatment and after removal of the orthodontic appliance, the dental buccal inclinations of the both groups increased in relation to the initial stage, with the exception of the mandibular molars in the smile arc group, and the intergroup comparison the conventional group presented statistical significantly greater increase of dental buccal inclinations than the smile arc group and the smile

arc group showed statistically significantly smaller arch dimensions than the conventional group. In the intergroup comparison of the changes that occurred during treatment (T2-T1), the smile arc group presented higher buccal dental inclinations statistical significantly than the conventional group in 3 of 24 evaluated dental inclinations. On the other hand, the smile arc group presented smaller buccal dental inclinations statistical significantly than the conventional group in 6 of the 24 dental inclinations. And in relationship of the arch dimensions the conventional group presented a greater increase in all the measures analyzed than smile arc group, and in 5 of the 8 analyzed arch widths there were statistically significant differences.
In the intragroup comparison of smile dimensions, in relation to the initial (T1) and final (T2) stages, dependent t test showed that the smile arc group, there was an increase in the Smile Width (SW), Maxillary Intercanine Width (MICW), and Buccal Corridor (BC), and in the Interlabial Distance (ILD) there was a decrease, but all these changes were not statistically significant. However, there was a statistically significant increase in the Smile Index (SI). Regarding the treatment changes (T2-T1) between the groups, none of the 5 analyzed variables presented statistically significant differences. The results of comparability of the groups of evaluators, one-way ANOVA and Tukey test showed statistically significant difference between the age of groups, the Dentists group presented an older age. Regarding gender, the chi-square test also showed the presence of a statistically significant difference between the groups. **Conclusion:** The conventional bonding group showed, in general, a greater dental buccal inclination and a larger transversal increase in the arch's dimensions. The 5 attractiveness variables analyzed showed no differences between groups. The perception of smile attractiveness, considered the highest rating for the Smile Arc bonding group.

Key words: Damon System, Self-ligating Appliance, Dental inclination, Dental Arch Widths, Attractiveness, Cone Beam Computed Tomography.

RESUMO

Comparação da atratividade do sorriso, inclinações dentarias e dimensões dos arcos dentários em pacientes tratados com aparelho autoligável, no sistema Damon, com colagem convencional e "Smile Arc"

Objetivo: O objetivo deste estudo retrospectivo foi avaliar se existe diferença na atratividade do sorriso, inclinações dentárias e dimensões das arcadas dentárias em pacientes tratados pelo Sistema Damon®, utilizando duas colagens ortodônticas distintas: convencional e "Smile Arc Protection". **Material e métodos**: A amostra foi composta por 40 pacientes (19 mulheres, 21 homens) com tratamento ortodôntico concluído que já possuem toda a documentação inicial e final, incluindo tomografia computadorizada de feixe cônico (TCFC). A amostra foi dividida em dois grupos: grupo 1 - 20 pacientes, 7 mulheres e 13 homens, com média de idade inicial de 23,75 + 4,03 e média de idade final de 26,87 + 4,09, tratados com sistema Damon com colagem convencional; grupo 2 - 20 pacientes, 12 mulheres e 8 homens, com média de idade inicial de 28,11 + 9,66 e média de idade final de 30,62 + 10,46, tratados com sistema Damon com colagem "Smile Arc". Oitenta imagens de TCFC, 40 pré-tratamento e 40 pós-tratamento foram avaliadas. As inclinações dentárias iniciais (T1) e finais (T2) e as dimensões das arcadas dentárias foram avaliadas e comparadas entre os dois grupos. Oitenta fotografias frontais do sorriso posado, 40 fotografias de pré-tratamento (T1) e 40 de pós-tratamento (T2) foram avaliadas para comparar a atratividade do sorriso entre os dois grupos e comparadas entre esses dois grupos. Foi criado um site com instruções de avaliação da atratividade do sorriso para os avaliadores. Os sorrisos eram randomizados automaticamente, cada vez que o usuário acessava a página. Os grupos de avaliadores foram compostos por 3 grupos: grupo 1 - 59 ortodontistas, grupo 2 - 62 dentistas e grupo 3- 57 leigos com média de idade de 39,83 (+10,48), 48,73 (+14,07) e 42,68 (+14,03) respectivamente. **Resultados**: Na comparação intergrupos da inclinação dentária na fase inicial (T1), o grupo convencional apresentou inclinação dentária estatisticamente significativamente maior do que o grupo "Smile Arc", e o grupo "Smile Arc" apresentou uma largura de arco menor que o grupo convencional. No estágio final (T2), após o término do tratamento ortodôntico e após a retirada do aparelho ortodôntico, as inclinações bucais dentais de ambos os grupos aumentaram em relação ao estágio inicial, com exceção dos molares inferiores do grupo "Smile Arc", e na comparação intergrupos, o grupo convencional apresentou aumento estatisticamente significativamente maior

das inclinações dentais vestibulares do que o grupo “Smile Arc” e este, apresentou dimensões de arco estatisticamente significativamente menores do que o grupo convencional. Na comparação intergrupos das mudanças ocorridas durante o tratamento (T2-T1), o grupo “Smile Arc” apresentou estatisticamente significativamente maiores inclinações dentárias vestibulares, do que o grupo convencional em 3 das 24 inclinações dentárias avaliadas. Por outro lado, o grupo “Smile Arc” apresentou inclinações dentárias vestibulares estatisticamente significantemente menores do que o grupo convencional em 6 das 24 inclinações dentárias. E em relação às dimensões do arco, o grupo convencional apresentou um aumento maior em todas as medidas analisadas do que o grupo “Smile Arc”, sendo que em 5 das 8 larguras de arco analisadas houve diferenças estatisticamente significantes.

Na comparação intragrupo das dimensões do sorriso, em relação aos estágios inicial (T1) e final (T2), o teste t dependente mostrou que no grupo “Smile Arc”, houve um aumento na Largura do Sorriso (SW), Largura Intercanino Maxilar (MICW), e Corredor Bucal (BC), e na Distância Interlabial (DPI) houve uma diminuição, mas todas essas alterações não foram estatisticamente significativas. No entanto, houve um aumento estatisticamente significativo no Índice de Sorriso (SI). Em relação às mudanças de tratamento (T2-T1) entre os grupos, nenhuma das 5 variáveis analisadas apresentou diferença estatisticamente significativa. Os resultados da comparabilidade dos grupos de avaliadores, ANOVA one-way e teste de Tukey mostraram diferença estatisticamente significante entre as idades dos grupos, o grupo Dentistas apresentou uma idade mais avançada. Em relação ao sexo, o teste do qui-quadrado também mostrou a presença de diferença estatisticamente significante entre os grupos. **Conclusão**: O grupo de colagem convencional apresentou, em geral, uma maior inclinação dentária vestibular e um maior aumento transversal nas dimensões do arco. As 5 variáveis de atratividade do sorriso analisadas não apresentaram diferenças entre os grupos. A percepção da atratividade do sorriso, considerada a classificação mais alta para o grupo de colagem Smile Arc.

Palavras-chave: Sistema Damon, Aparelho Autoligável, Inclinação Dentária, Larguras do Arco Dentário, Atratividade, Tomografia Computadorizada de Feixe Cônico.

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LIST OF ABREVIATIONS AND ACRONYMS

T1	Pretreatment
T2	Posttreatment
T2 – T1	Treatment changes
CBCT	Cone Beam Computed Tomography
Mx	Maxilla
Md	Mandible
SD	Standard deviation
BC	Buccal Corridor
SW	Smile Width
MICW	Maxillary Intercanine Width
SI	Smile Index
ILD	Interlabial Distance
3-3 width	Intercanine width
4-4 width	Interpremolar 1 width
5-5 width	Interpremolar 2 width
6-6 width	Intermolar 1 width

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1 INTRODUCTION

1 INTRODUCTION

For a long time, the results of successful orthodontic treatments were based only on occlusal factors and lateral cephalometric measurements. Information is needed concerning soft-tissue and dental relationships from a frontal view to provide a wider basis for assessing facial esthetics.[1]

Common perceptions about facial aesthetics are usually based on author`s opinions rather than scientific methods. This might be explained by the difficulty to qualify and quantify beauty and the close association between esthetics and the fine arts, which questions the validity of measuring beauty. However, the measurement of what is beautiful or the perception of beauty in dentistry is fundamental for providing scientific data that can guide diagnosis and treatment planning.[2]

Patients today seeking esthetic treatment are looking for enhancement of their appearance for improved quality of life. Interdisciplinary treatment also has been necessary, with the inclusion of soft tissue and periodontal components of the dentition and smile assessment, as well as the whole face.[3]

Facial and dental esthetics have become greatly important during the last decade. Currently, there is to focus on esthetics, with emphasis on the soft tissues. The increasing demand for a “beautiful smile” requires a harmonious balance between soft tissue and occlusion.[4]

The “art of the smile” is reported as the orthodontist's ability to evaluate the patient in 3-dimensions and use the latest technologies to document and communicate the treatment strategy to patients and colleagues involved in interdisciplinary treatment planning.[5]

Smile is also an important factor in facial attractiveness and it is important to differentiate posed or social smile from pleasant or involuntary smile. The posed or social smile is a voluntary smile that is used in a social environment or when posing for photographs, while the pleasant smile is involuntary and reflects the emotion of the moment.[5]

Many variables may influence the attractiveness of the smile, among which we highlight: the width of the buccal corridors (BC) and the smile area, evaluated by smile index (SI).[5,6]

The buccal corridor is the transverse dimension of the smile and is measured from the angle of the distal line of the maxillary canine to the interior portion of the commissure of the lips. The smile area is described by the area framed the vermilion borders of the lips during the posed smile.[5-7]

The technological developments in orthodontic materials have grown exponentially and provided the professional with tools for more efficient orthodontic treatment and comfort for the patient, thus improving its quality of life. Self-ligating orthodontic appliances are currently popular among orthodontists. They allow to perform teeth alignment and leveling more effectively, with a relatively reduced chair time and less need for dental extractions, in cases of significant crowding compared with conventional edgewise brackets.[8]

The Damon® system (Ormco Corp., Glendora, CA, USA) is a passive self-ligating (PSL) bracket system that was originally introduced in 1994. Damon's philosophy is based on the use of light forces only sufficient to initiate tooth movement.[8]

The fundamental principle of this force is that it should be light enough to prevent obstruction of the periodontal membrane blood vessels and allow biochemical cells and messengers to be transported to the side where bone is being resorbed and where bone apposition will occur and then allow dental movement.[9]

The positioning of brackets used in the Damon® system follows the principles suggested by Andrews[10], where brackets are positioned at a midpoint of the facial axis of the clinical crown of teeth with the vertical positioners of these brackets parallel to that axis.[11]

Recently, another way of bracket positioning, called “Bracket positioning for Smile Arc Protection”, was considered an innovation that combined the art of contemporary aesthetics with the science behind three-dimensional control of dental positioning, achieving superior and more predictable aesthetic results at the orthodontic treatment.[12]

Positioning the upper brackets for protection or enhancement of the smile arc has been called “Smile Arc Protection”. Although the positioning of brackets in this technique is individualized to meet the aesthetic needs of each patient, usually the upper incisor brackets are bonded more gingivally than the canine brackets. The lower posterior brackets are also placed more gingivally to allow occlusion, while the occlusal-gingivally positioning of the mandibular incisors depends on the vertical relationship of the bite, and the lower anterior brackets are placed more incisal to improve overbite or more gingivally to correction the open bite.[12]

The advantages defended by the authors of the Damon system include: the possibility of increasing the size of the dental arches, without periodontal compromise, with alveolar bone accompanying tooth movement[11], and reduction of tooth extractions, due to the this increase in dental arch size, would be possible the crowded teeth to be aligned without the need for dental extractions. The increase in arch length and transverse dimensions without performing orthopedic procedures, such as maxillary disjunction, results from distal movement of the posterior teeth, advancement of the anterior teeth, and expanding the arch transversely.[13]

Dental inclinations with displacement of the tooth from the center of its bone base may lead to an increased risk of bone defect onset or worsening [14,15], and gingival recessions.[16,17]

The most appropriate exam for the study of maxillary and mandibular alveolar bone changes is cone-beam computed tomography (CBCT), because it allows axial, sagittal and frontal cuts with good accuracy and precision.[18,19]

Therefore, this study assessed whether there is a significant difference in relation to the smile attractiveness, dental inclination, and dental arch widths in patients with orthodontic treatment already completed by the Damon system with two types of bracket bonding, conventional[20] and “Smile Arc Protection.[21]

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 B).

- **Article 1 -** Comparison of smile attractiveness in patients treated with Damon system self-ligating appliance, using two different bonding: conventional and “smile arc”.

- **Article 2 –** Comparison of dental inclination and dental arch widths in patients treated with Damon system self-ligating appliance, using two different bonding: conventional and “smile arc”.

2.1 ARTICLE 1

COMPARISON OF SMILE ATTRACTIVENESS IN PATIENTS TREATED WITH DAMON SYSTEM SELF-LIGATING APPLIANCE, USING TWO DIFFERENT BONDING: CONVENTIONAL AND "SMILE ARC".

ABSTRACT

Introduction: In this retrospective study, the purpose was to evaluate whether there is a difference in the smile attractiveness in patients treated by the Damon® System, using two different orthodontic bonding: conventional and "Smile Arc Protection". And whether there is an influence in the buccal corridor and smile area. **Material and methods:** The sample consisted of 40 patients (19 women, 21 men) with completed orthodontic treatment who already have all the initial and final documentation, including cone beam computed tomography (CBCT). The sample was divided into two groups: group 1 - 20 patients, 7 women and 13 men, with an initial mean age of 23.75 ± 4.03 and final age mean 26.87 ± 4.09, treated with Damon system using conventional bonding; group 2 - 20 patients, 12 women and 8 men, with an initial mean age of 28.11 ± 9.66 and final age mean 30.62 ± 10.46, treated with Damon system using "Smile Arc" bonding. Eighty frontal photographs of the posed smile, 40 pretreatment (T1) and 40 posttreatment (T2) photographs were evaluated to compare the smile attractiveness between the two groups, and compared between these two groups. A website with the smile attractiveness evaluation instructions was created for the raters. Through e-mail, each possible evaluator received a link to the evaluations form. The smiles were automatically randomized, each time the user accessed the webpage. The groups of evaluators consisted of 3 groups: group 1 - 59 orthodontists, group 2 - 62 dentists and group 3- 57 laypeople with a mean age of 39.83 (±10.48), 48.73 (±14.07) and 42.68 (±14.03) respectively. **Results:** In the intragroup comparison of smile dimensions, in relation to the initial (T1) and final (T2) stages, dependent t test showed that in the smile arc group, there was an increase in the Smile Width (SW), Maxillary Intercanine Width (MICW), and Buccal Corridor (BC), and in the Interlabial Distance (ILD) there was a decrease, but all these changes were not statistically significant. However, there was a statistically significant increase in the Smile Index (SI). Regarding the treatment changes (T2-T1) between the groups, none of the 5 analyzed variables presented statistically significant differences. The results of comparability of the groups of evaluators, one-way ANOVA and Tukey test showed a statistically significant difference between the age of groups, the Dentists group presented an older age. Regarding gender, the chi-square test also showed the presence of a statistically significant difference between the groups. **Conclusion:** The 5 variables analyzed showed no differences between groups. The perception of smile attractiveness considered the highest rating for the Smile Arc bonding group.

Keywords: Damon System, Self-ligating Appliance, Attractiveness, Smile Width, Buccal Corridor, and Smile Index.

INTRODUCTION

For a long time, the results of successful orthodontic treatments were based only on occlusal factors and lateral cephalometric measurements. Information is needed concerning soft-tissue and dental relationships from a frontal view to provide a wider basis for assessing facial esthetics.[1,2]

Common perceptions about facial aesthetics are usually based on the author`s opinions rather than scientific methods. This might be explained by the difficulty to qualify and quantify beauty and the close association between esthetics and the fine arts, which questions the validity of measuring beauty. However, the measurement of what is beautiful or the perception of beauty in dentistry is fundamental for providing scientific data that can guide diagnosis and treatment planning.[3]

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Many variables may influence the attractiveness of the smile, among which we highlight: the width of the buccal corridors (BC) and the smile area, evaluated by smile index (SI).[7,8]

The buccal corridor is the transverse dimension of the smile and is measured from the angle of the distal line of the maxillary canine to the interior portion of the

commissure of the lips. The smile area is described by the area framed by the vermilion borders of the lips during the posed smile.[7-9]

The technological developments in orthodontic materials have grown exponentially and provided the professional with tools for more efficient orthodontic treatment and comfort for the patient, thus improving its quality of life. Self-ligating orthodontic appliances are currently popular among orthodontists. They allow to perform teeth alignment and leveling more effectively, with a relatively reduced chair time and less need for dental extractions, in cases of significant crowding compared with conventional edgewise brackets.[10]

The Damon® system (Ormco Corp., Glendora, CA, USA) is a passive self-ligating (PSL) bracket system that was originally introduced in 1994. Damon's philosophy is based on the use of light forces only sufficient to initiate tooth movement.[10]

The fundamental principle of this force is that it should be light enough to prevent obstruction of the periodontal membrane blood vessels and allow biochemical cells and messengers to be transported to the site where the bone is being resorbed and where bone apposition will occur and then allow dental movement.[10]

The positioning of brackets used in the Damon® system follows the principles suggested by Andrews[11], where brackets are positioned at a midpoint of the facial axis of the clinical crown of teeth with the vertical positioners of these brackets parallel to that axis.[12]

Recently, another way of bracket positioning, called “Bracket positioning for Smile Arc Protection”, was considered an innovation that combined the art of contemporary aesthetics with the science behind three-dimensional control of dental positioning, achieving superior and more predictable aesthetic results at the orthodontic treatment.[13]

Positioning the upper brackets for protection or enhancement of the smile arc has been called “Smile Arc Protection”. Although the positioning of brackets in this technique is individualized to meet the aesthetic needs of each patient, usually the upper incisor brackets are bonded more gingivally than the canine brackets. The lower posterior brackets are also placed more gingivally to allow occlusion, while the occlusal-gingivally positioning of the mandibular incisors depends on the vertical relationship of the bite, and the lower anterior brackets are placed more incisal to improve overbite or more gingivally to correct the open bite.[13]

Therefore, this study assessed whether there is a significant difference in relation to the smile attractiveness in patients with orthodontic treatment already completed by the Damon system with two types of bracket bonding, conventional[14] and “Smile Arc Protection”.[15]

OBJECTIVES

Evaluate whether there is a difference in the smile attractiveness in patients treated by the Damon® System, using two different orthodontic bonding: conventional and “Smile Arc Protection”.

Secondly, whether there is an influence in the buccal corridor and smile area when using these two different types of orthodontic bonding.

MATERIAL AND METHODS

This retrospective study was approved by the Ethics Research Committee of Bauru Dental School, University of São Paulo, Brazil (protocol number: 24540619.8.0000.5417; decision number: 3.959.613).

Sample Calculation

The sample calculation was based on an alpha error of 5% and a beta error of 20%, with 80% test power to detect a minimum difference of 1.1 points in the evaluation of smile attractiveness, considering the standard deviation of 1.2.[16] Thus, the sample calculation resulted in the need for 20 patients in each group.

Material

In this retrospective study, the sample consisted of 40 patients, 19 women (47,5%) and 21 men (52,5%), with completed orthodontic treatment who already have all the initial and final documentation, including cone beam computed tomography (CBCT). The sample was divided into two groups: group 1 - 20 patients, 7 women and 13 men, with an initial mean age of 23.75 $\pm$ 4.03 and final age mean 26.87 $\pm$ 4.09, treated with Damon system using conventional bonding; group 2 - 20 patients, 12 women and 8 men, with an initial mean age of 28.11 $\pm$ 9.66 and final age mean 30.62 $\pm$ 10.46, treated with Damon system using “Smile Arc” bonding.

Eighty frontal photographs of the posed smile, 40 pretreatment and 40 posttreatment photographs were evaluated to compare the smile attractiveness between the two groups, and compared between these two groups.

Inclusion criteria

- Patients with Angle Class I or Class II malocclusions
- Presence of all permanent teeth up to the first molar
- Absence of craniofacial anomalies
- Presence of initial and final orthodontic documentation
- Individuals treated with Damon system self-ligating fixed appliance
- Patients with absence of periodontal disease, agenesis or tooth loss.

Methods

Photograph's standardization

The subjects were instructed to seat maintaining the natural head position — a standardized and reproducible head position in an upright and natural posture with the visual axis in the horizontal[17]. They were also instructed to give a posed and as natural smile as possible with their teeth in MI (Maximum intercuspation). Several photos were taken of each subject at posed smile[18,19] and the one which appeared more natural was chosen[2,20,21]. The posed smile is voluntary and not elicited by emotion, can be a learned greeting or a signal of appeasement and can be sustained, and is reliably repeatable. It is not spontaneous and is unstrained and posed[8]. Patients were trained before the photographs.

Frontal posed smiling photographs were taken of each patient by the same investigator with a Canon T7 digital camera (Canon Corporation), assembled with a Canon 100 mm macro lens and circular macro flash (Shenzhen Yongnuo Photography Equipment). The macro lens was adjusted to focus at a constant object-to-lens distance obtaining an image of the lower facial height.

Photograph equipment`s standardization

All photographs were obtained in manual mode, color, fine quality, ISO (International Organization of Standardization) 800, aperture of at least 16, and a shutter speed of 60. The macro lens will be adjusted to give the focus on the patient's

lips[2], at a distance of 60 cm from the soft tissue, obtaining an image of the lower third of the face, which goes approximately from the tip of the nose to the middle of the chin[19]. The standardized flash is multi ¼.

Confounding factors reduction

The photographs were imported into Photoshop (Adobe Systems CS6, San Jose, California, USA) to crop the nose, cheeks and chin to reduce the number of confusing variables. Facial blemishes and facial hair were removed from the smiling photographs. Subsequently, the photographs were converted to black and white[1,16,19,22,23](Fig. 1). All images were in TIF format with 300 dpi of resolution.

The photographs were viewed under the same magnification on the computer screen and the smile photographs were cropped at a proportional standardized size of 21 × 12.4 cm.

Smile attractiveness evaluation

A website with the smile attractiveness evaluation instructions was created for the raters. Through e-mail, each possible evaluator received a link to the evaluations form. The smiles were automatically randomized, each time the user accessed the webpage[24].

The attractiveness of each smile was judged and scored according to a 10-point numerical scale. The scores were shown under each photograph and varied from 1 to 10, representing the most unattractive and the most attractive smile, respectively[25]. During the evaluation, one photograph was shown each time (Fig. 2).

The groups of evaluators consisted of 3 groups: group 1 - 59 orthodontists, group 2 - 62 dentists and group 3- 57 laypeople with a mean age of 39.83 ($\pm$10.48), 48.73 ($\pm$14.07) and 42.68 ($\pm$14.03) respectively.

Buccal corridor evaluation

The buccal corridor (BC) was evaluated. Initially, the following attributes of the smile were measured in millimeters through Adobe Photoshop software by using vertical lines as limits (Fig. 3):

A. Smile width (SW): the distance from commissure to outer commissure[18,19].

B. Maxillary intercanine width (MICW): the distance from the distal aspect of the right canine to the distal aspect of the left canine.

By using these measurements, the buccal corridor was calculated as percentages of the commissure width.

BC = SW — MICW / SW × 100.

Smile area evaluation

To visualize and quantify de frontal smile area was used the smile index[7,8](SI), which describes the area framed by the vermilion borders of the lips during the posed smile. The smile index is determined by dividing the inter-commissure width or smile width (SW) by the interlabial distance (ILD) during smile (Fig. 4):

A. Inter-commissure width or smile width (SW).

C. Interlabial distance (ILD).

SI = SW / ILD

Error Study

The intraexaminer reliability of the smile photographs measurements was assessed by the intraclass correlation coefficient (ICC)[26]. After a month interval, 24 smile photographs were re-measured, and these measurements were compared.

To evaluate the precision of the evaluators in rating the smile attractiveness of the silhouettes of the questionnaire, two silhouettes were randomly repeated throughout the questions, and the Intraclass correlation coefficient (ICC) was used[26].

STATISTICAL ANALYSIS

The normality of data was checked with Shapiro-wilk test.

Intergroup comparability of initial and final ages, treatment time and Little irregularity index was performed with independent t tests and sex distribution was performed with chi-square test.

Intragroup comparison of the initial and final stages of each group was performed with dependent t test. Intergroup comparison of the smile dimensions and attractiveness was performed with independent t test.

The comparability of the age and sex distribution of the three groups of evaluators was performed with one-way ANOVA and Tukey test and chi-square test,

respectively. The score of the smile attractiveness between the three groups of evaluators was compared with one-way ANOVA and Tukey test.

Statistical analysis was performed with Statistica software (Statistica for Windows, version 12.0, Statsoft, Tulsa, Okla) and the results were considered significant for $p<0.05$.

RESULTS

Intraclass correlation coefficients (ICCs) of the smile photographs measurements varied from 0.89 to 0.96, and the ICCs of the precision of the evaluators in rating the smile attractiveness varied from 0.82 to 0.91. These ICCs indicate an excellent intra-rater agreement[27].

Chi-square test showed that the two groups were not significantly different in terms of sex distribution ($P = 0.113$). There was no significant distinction in the mean initial age and mean final age between the groups ($P = 0.098$ and $P = 0.144$, respectively). The intergroup comparability of the treatment time, independent t-test showed no statistically significant differences ($P = 0.107$).

Regarding to the intergroup comparability of the mandible Little irregularity index and maxilla Little irregularity index analysis, independent t-test showed no statistically significant differences ($P = 0.149$ and $P = 0.792$, respectively) (Table I).

In the intragroup comparison of smile dimensions, in relation to the initial (T1) and final (T2) stages, dependent t test showed that in the smile arc group, there was an increase in the Smile Width (SW), Maxillary Intercanine Width (MICW), and Buccal Corridor (BC), and in the Interlabial Distance (ILD) there was a decrease, but all these changes were not statistically significant. However, there was a statistically significant increase in the Smile Index (SI).

In the conventional group, there was a decrease in SW, MICW, BC, and ILD. However, only ILD presented a statistically significant difference. As in the smile arc group, there was an increase in the smile index, therefore it was not statistically significant (Table II).

In the intergroup comparison of smile dimensions, independent t test showed, at the initial stage (T1), in all 5 variables analyzed, the smile arc group showed greater than the conventional group, however, only the SW and MICW presented statistically significant differences.

At the final stage (T2), a greater increase was also observed in all variables in the smile arc group than the conventional group, since the SW, MICW and BC showed statistically significant differences.

Regarding the treatment changes (T2-T1) between the groups, none of the 5 analyzed variables presented statistically significant differences (Table III).

The results of comparability of the groups of evaluators, one-way ANOVA and Tukey test showed a statistically significant difference between the age of groups, the Dentists group presented an older age. Regarding gender, the chi-square test also showed the presence of a statistically significant difference between the groups (Table IV).

The intergroup comparison of the smile attractiveness at the end of the treatment (T2), obtained from the results of the evaluations carried out through the website, by the groups of evaluators, independent t test showed that the Smile Arc group had a statistically significantly higher smile attractiveness than the Conventional group (Table V).

When comparing the three groups of evaluators in relation to their evaluations of the attractiveness of the smile, the one-way ANOVA and Tukey test showed that in all three groups the ratings were better for the smile arc group, whereas in the Dentists group there was a statistically significant higher smile attractiveness rating for both, Conventional and Smile Arc groups, when compared to the other groups of evaluators (Table VI).

DISCUSSION

The main purpose of this study was to assess the effects of the use Damon® system passive self-ligating appliance, comparing two different bracket bonding protocols, in a no-extractions approach, on the smile attractiveness. Both groups used the same bracket, Damon 3MX, with the same wire sequence: .014"cuniti, .014X.025"cuniti, .018X.025cuniti and .019X.025" steel.

The conventional protocol for bracket positioning is the bracket positions method with its center close to the center of the clinical crown, as recommended by Andrews.[11]

The “Smile Arc” protocol is the method for bracket positioning that follows an exacting bracket placement to protect or enhance the smile and align buccal segment

cusp tips and marginal ridges. The upper incisor brackets are generally placed more gingivally than the canine brackets. The lower posterior brackets are placed somewhat gingivally to avoid occlusion, while the lower anterior brackets are placed somewhat incisally to optimize overbite.[15]

Our study was retrospective since the two self-ligating samples were previously treated. Thus, in a retrospectively designed study, intergroup compatibility is very important to avoid the influence of other factors on the results.

There was concern in selecting comparable groups according to the amount of initial crowding, sex distribution, to reduce the factors that could influence judgment of smile attractiveness (Table I). This fact is very important because aged smiles undergo several changes, such as a decrease in exposure of the maxillary incisors, greater exposure of the mandibular incisor, the smile gets narrower vertically and there is a decrease in the upper lip thickness.[28]

The results of this study showed that the smile arc bonding group had a wider smile, with a statistically significant greater increase in the smile index, in contrast to the conventional bonding group showed a lower smile exposure with a statistically significant decrease in the interlabial distance (Table II).

Despite this finding, in the intergroup comparison of the changes that occurred between the phases (T2-T1), no significant differences were observed in the smile width, maxillary intercanine width, buccal corridor, interlabial distance and smile index (Table III). Some studies corroborate our findings, where variables such as buccal corridor and smile width do not seem to present significant differences between the different types of orthodontic treatment protocols.[24,29]

Regarding the smile attractiveness judgment, this study showed that there is a significant difference in the intergroup comparison, with the Smile Arc bonding group being statistically significantly better qualified than the conventional bonding group (Table V). And when comparing the 3 groups of evaluators: orthodontists, dentists and laypeople, there was a better assessment of the smile attractiveness for the Smile Arc group, being that, the dentist group gave higher overall ratings statistically significantly for the Smile Arc group. In contrast to these findings, some previous studies that assessed smile attractiveness in different groups of raters concluded that there was no difference in the perceptions of dental professionals and laypeople.[16,18,22,23,30-32] In the present study, laypeople gave lower scores to the smile attractiveness than the

orthodontists and dentists, which is in agreement with the finding described in the literature (Table VI).[24,33,34]

This could probably be because the group of dentists is older (Table IV), so the greater number of years in the clinical practice, it could significantly affect the visualization and judgment of the attractiveness of smiles.[33]

The fact that there are many individual variables in both groups such as muscle factors, tooth inclination and different amounts of crowding is not a surprise. The findings of this study indicate that the buccal corridor and the smile display, represented by the smile index, are probably not affected by the two types of orthodontic bonding analyzed. On the other hand, in the evaluations of real clinical photographs, there were significant differences between laypersons, orthodontists and dentists in their preferences for the attractiveness of the smile achieved with the “Smile Arc” orthodontic bonding.[24,33]

CONCLUSIONS

There was no interference of the two types of orthodontic bonding analyzed in the buccal corridor and smile index.

There was a statistically significant difference in the perception of smile attractiveness by orthodontists, dentists and laypeople, which considered the highest rating for the “Smile Arc” bonding group.

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FIGURE LEGENDS

Fig. 1 – Reduction of confounding variables: (A) original image, (B) image cropped at a standardized proportion of 21 × 12.4 cm, (C) elimination of facial blemishes and facial hair, (D) image conversion to black and white.

Fig. 2 – Example of smile photograph for evaluation.

Fig. 3 – Measurement of the following attributes of the smile by using the vertical lines as limits: (A) smile width, (B) maxillary intercanine width.

Fig. 4 – Smile index: (A) Smile width, (C) Interlabial distance.

Fig. 1

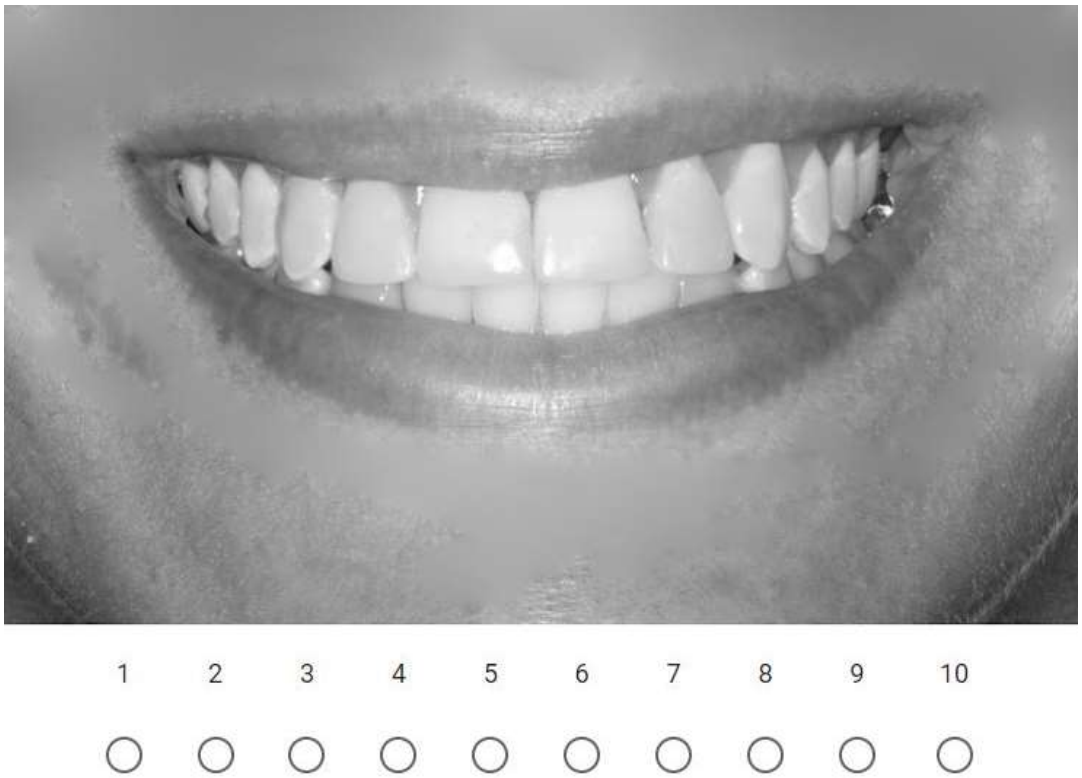

Fig.2

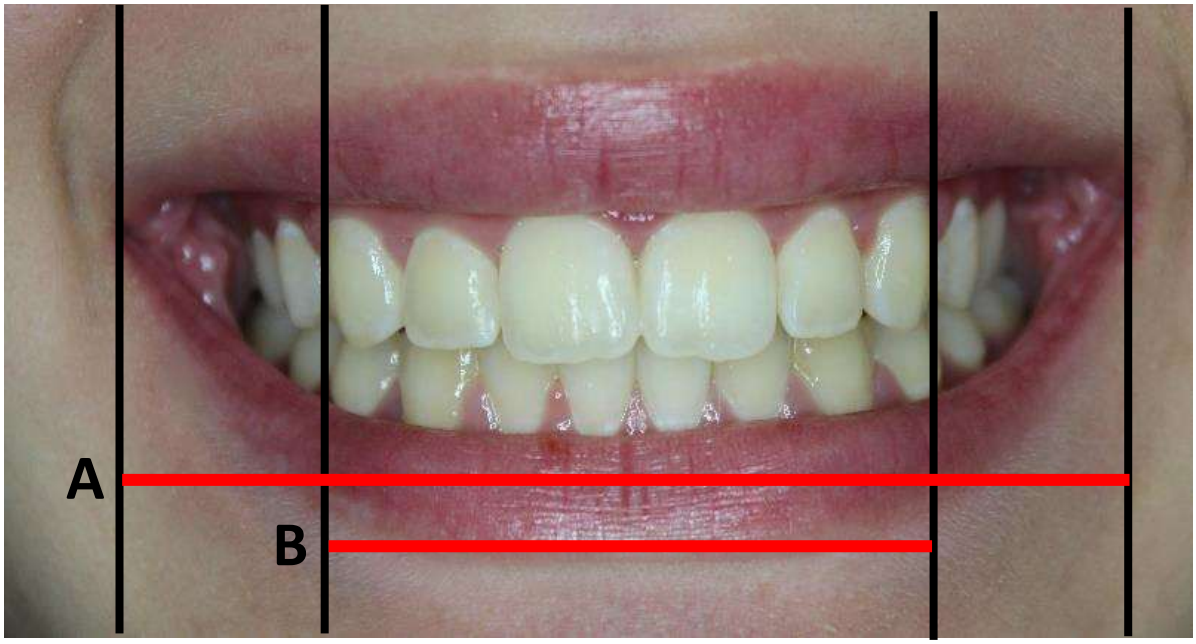

Fig. 3

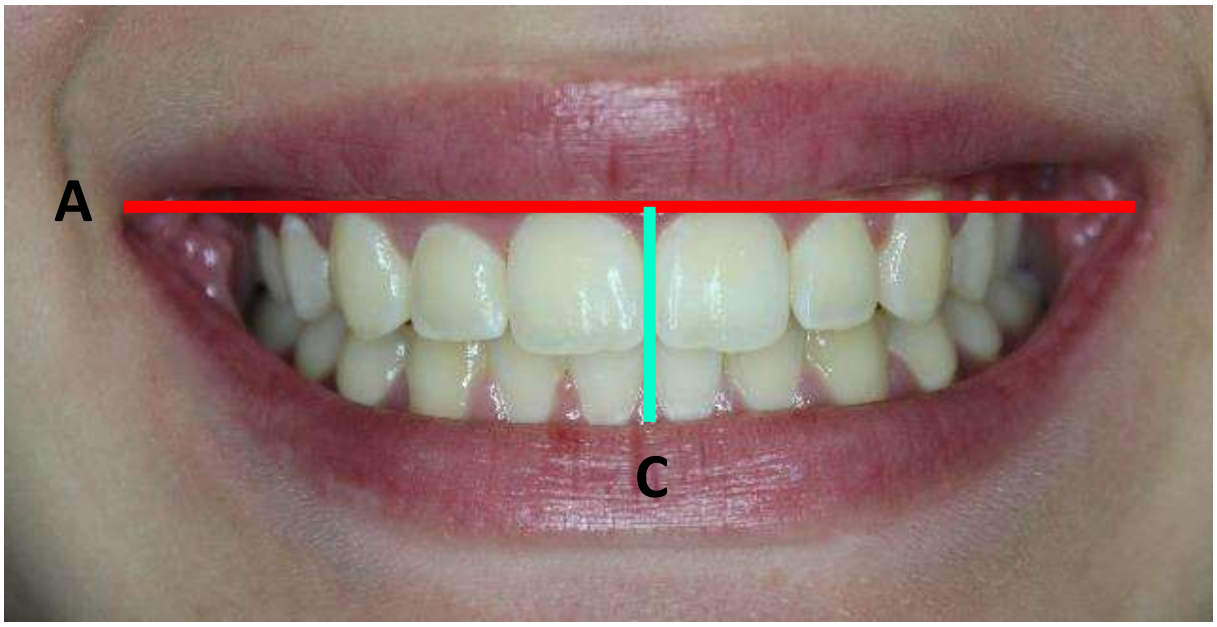

Fig. 4

Table I. Intergroup comparability of initial and final ages, treatment time, Little irregularity index and sex distribution.

Variables	**SMILE ARC (n=20)**	**CONVENTIONAL (n=20)**	**P**
	Mean (SD)	**Mean (SD)**	
Initial Age (years)	28.11 (9.66)	23.75 (4.03)	0.098 [T]
Final Age (years)	30.62 (10.46)	26.87 (4.09)	0.144 [T]
Treatment time (years)	2.51 (1.09)	3.12 (1.24)	0.107 [T]
Mx Little irregularity index (mm)	6.92 (5.26)	7.27 (2.66)	0.792 [T]
Md Little irregularity index (mm)	3.95 (2.98)	5.13 (1.99)	0.149 [T]
Sex			X^2 =2.51
Male	8	13	DF=1
Female	12	7	p=0.113 [α]

[T] independent t-test; [α] chi-square test

Table II. Intragroup comparison of the initial and final stages of the smile dimensions (dependent t test).

Variables (mm)	INITIAL STAGE (T1) (n=20)		FINAL STAGE (T2) (n=20)		P
	Mean	SD	Mean	SD	
SMILE ARC GROUP					
SW	17.44	1.74	17.55	2.02	0.799
MICW	10.82	1.10	10.89	1.40	0.801
BC	37.75	5.18	37.89	4.21	0.902
ILD	3.23	0.87	2.93	0.74	0.119
SI	5.79	1.80	6.41	2.17	0.020*
CONVENTIONAL GROUP					
SW	14.97	2.18	14.57	2.36	0.456
MICW	9.69	1.29	9.64	1.58	0.887
BC	34.96	4.24	33.68	3.87	0.179
ILD	3.12	0.75	2.68	0.60	0.027*
SI	5.03	1.22	5.62	1.24	0.094

* Statistically significant at $p<0.05$

Table III. Intergroup comparison of the smile dimensions at the initial stage (T1), final stage (T2) and treatment changes (T2-T1) (independent t test).

Variables (mm)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
INITIAL STAGE (T1)					
SW	17.44	1.74	14.97	2.18	0.000*
MICW	10.82	1.10	9.69	1.29	0.005*
BC	37.75	5.18	34.96	4.24	0.071
ILD	3.23	0.87	3.12	0.75	0.671
SI	5.79	1.80	5.03	1.22	0.127
FINAL STAGE (T2)					
SW	17.55	2.02	14.57	2.36	0.000*
MICW	10.89	1.40	9.64	1.58	0.012*
BC	37.89	4.21	33.68	3.87	0.002*
ILD	2.93	0.74	2.68	0.60	0.247
SI	6.41	2.17	5.62	1.24	0.163
TREATMENT CHANGES (T2-T1)					
SW	0.11	1.91	-0.39	2.30	0.457
MICW	0.07	1.27	-0.05	1.57	0.787
BC	0.14	5.17	-1.28	4.10	0.340
ILD	-0.30	0.81	-0.44	0.81	0.588
SI	0.62	1.10	0.59	1.49	0.930

* Statistically significant at $p<0.05$

Table IV. Results of comparability of the groups of evaluators.

Variables	**Orthodontists N=59**	**Dentists N=62**	**Laypeople N=57**	**P**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Age (years)	39.83 (10.48) ^{A}	48.73 (14.07) ^{B}	42.68 (14.03) ^{A}	**0.000*** ^{O}
Sex				X^2 =14.95
Female	29	46	46	DF=2
Male	30	16	11	p=**0.000*** $^{\alpha}$

* Statistically significant for p<0.05
^{O} One-way ANOVA and Tukey test
$^{\alpha}$ chi-square test
Different letters in a row indicate the presence of a statistically significant difference between the groups.

Table V. Results of intergroup comparison of the smile attractiveness (independent t test).

Smile attractiveness	**SMILE ARC**		**CONVENTIONAL**		**p**
	Mean	**SD**	**Mean**	**SD**	
Final (T2)	6.99	2.13	6.08	2.32	**0.000***

* Statistically significant for p<0.05

Table VI. Comparison of the three groups of evaluators (one-way ANOVA and Tukey test).

Smile attractiveness	**Orthodontists N=59**	**Dentists N=62**	**Laypeople N=57**	**P**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
CONVENTIONAL	5.92 (2.18) ^{A}	6.30 (2.37) ^{B}	6.02 (2.41) ^{A}	**0.000***
SMILE ARC	6.88 (1.96) ^{A}	7.23 (2.19) ^{B}	6.84 (2.20) ^{A}	**0.000***

* Statistically significant for $p<0.05$

Different letters in a row indicate the presence of a statistically significant difference between the groups.

2.2 ARTICLE 2

COMPARISON OF DENTAL INCLINATION AND DENTAL ARCH WIDTHS IN PATIENTS TREATED WITH DAMON SYSTEM SELF-LIGATING APPLIANCE, USING TWO DIFFERENT BONDINGS: CONVENTIONAL AND "SMILE ARC".

ABSTRACT

Introduction: In this retrospective study, the purpose was to evaluate whether there is a difference in dental inclinations and dental arches dimensions in patients treated by the Damon® System, using two different orthodontic bonding: conventional and "Smile Arc Protection". **Material and methods:** The sample consisted of 40 patients (19 women, 21 men) with completed orthodontic treatment who already have all the initial and final documentation, including cone beam computed tomography (CBCT). The sample was divided into two groups: group 1 - 20 patients, 7 women and 13 men, with an initial mean age of 23.75 ± 4.03 and final mean age 26.87 ± 4.09, treated with Damon system using conventional bonding; group 2 - 20 patients, 12 women and 8 men, with an initial mean age of 28.11 ± 9.66 and final age mean 30.62 ± 10.46, treated with Damon system using "Smile Arc" bonding. Eighty CBCT images, 40 pretreatment and 40 posttreatment were evaluated. Initial and final dental inclinations, and dental arches dimensions were evaluated, and compared between the groups. **Results:** In the intergroup comparison of the dental inclination at the initial stage (T1), the conventional group was presenting statistically significantly greater dental inclination than the smiler arc group, and the smile arc group showed a smaller arch width than the conventional group. In the final stage (T2), after the end of orthodontic treatment and after removal of the orthodontic appliance, the dental buccal inclinations of both groups increased in relation to the initial stage, except for the mandibular molars in the smile arc group, and the intergroup comparison the conventional group presented a statistically significant greater increase of dental buccal inclinations than the smile arc group and the smile arc group showed statistically significantly smaller arch dimensions than the conventional group. In the intergroup comparison of the changes that occurred during treatment (T2-T1), the smile arc group presented higher buccal dental inclinations statistically significant than the conventional group in 3 of 24 evaluated dental inclinations. On the other hand, the smile arc group presented smaller buccal dental inclinations statistically significant than the conventional group in 6 of the 24 dental inclinations. Regarding arch dimensions, the conventional group presented a greater increase in all the measures analyzed than smile arc group, and in 5 of the 8 analyzed arch widths, there were statistically significant differences. **Conclusion:** The conventional bonding group showed, in general, a greater dental buccal inclination and a larger transversal increase in the arch's dimensions.

Keywords: Damon System, Self-ligating Appliance, Dental inclination, Dental Arch Widths, Cone Beam Computed Tomography.

INTRODUCTION

The technological developments in orthodontic materials have grown exponentially and provided the professional with tools for more efficient orthodontic treatment and comfort for the patient, thus improving its quality of life. Self-ligating orthodontic appliances are currently popular among orthodontists. They allow to perform teeth alignment and leveling more effectively, with a relatively reduced chair time and less need for dental extractions, in cases of significant crowding compared with conventional edgewise brackets.[1]

The Damon system (Ormco Corp., Glendora, CA, USA) is a passive self-ligating (PSL) bracket system that was originally introduced in 1994. Damon's philosophy is based on the use of light forces only sufficient to initiate tooth movement.[1]

The fundamental principle of this force is that it should be light enough to prevent obstruction of the periodontal membrane blood vessels and allow biochemical cells and messengers to be transported to the site where the bone is being resorbed and where bone apposition will occur and then allow dental movement.[1]

The positioning of brackets used in the Damon system follows the principles suggested by Andrews[2], where brackets are positioned at a midpoint of the facial axis of the clinical crown of teeth with the vertical positioners of these brackets parallel to that axis.[3]

Recently, another way of bracket positioning, called “Bracket positioning for Smile Arc Protection”, was considered an innovation that combined the art of contemporary aesthetics with the science behind three-dimensional control of dental positioning, achieving superior and more predictable aesthetic results at the orthodontic treatment.[4]

Positioning the upper brackets for protection or enhancement of the smile arc has been called “Smile Arc Protection”. Although the positioning of brackets in this technique is individualized to meet the aesthetic needs of each patient, usually the upper incisor brackets are bonded more gingivally than the canine brackets. The lower posterior brackets are also placed more gingivally to allow occlusion, while the occlusal-gingivally positioning of the mandibular incisors depends on the vertical relationship of the bite, and the lower anterior brackets are placed more incisal to improve overbite or more gingivally to correct the open bite.[4]

The advantages defended by the authors of the Damon system include the possibility of increasing the size of the dental arches, without periodontal compromise, with alveolar bone accompanying tooth movement[3], and reduction of tooth extractions, due to this increase in dental arch size, would be possible the crowded teeth to be aligned without the need for dental extractions. The increase in arch length and transverse dimensions without performing orthopedic procedures, such as maxillary disjunction, results from the distal movement of the posterior teeth, advancement of the anterior teeth, and expanding the arch transversely.[5]

Dental inclinations with displacement of the tooth from the center of its bone base may lead to an increased risk of bone defect onset or worsening [6,7], and gingival recessions[8,9].

The most appropriate exam for the study of maxillary and mandibular alveolar bone changes is cone-beam computed tomography (CBCT), because it allows axial, sagittal and frontal cuts with good accuracy and precision.[10,11]

Therefore, this study will assess by CBCT whether there is a significant difference in dental inclination, bone thickness and dental arch widths in patients with orthodontic treatment already completed by the Damon system with two types of bracket bonding, conventional and “Smile Arc Protection”.

OBJECTIVES

To evaluate whether there is a difference in dental inclinations and dental arches dimensions in patients treated by the Damon® System, using two different orthodontic bonding: conventional and “Smile Arc Protection”.

MATERIAL AND METHODS

This retrospective study was approved by the Ethics Research Committee of Bauru Dental School, University of São Paulo, Brazil (protocol number: 24540619.8.0000.5417; decision number: 3.959.613).

Sample Size Calculation

The sample size calculation was based on an alpha error of 5% and a beta error of 20%, with 80% test power to detect a minimum difference of 1.1 points in the

evaluation of smile attractiveness, considering the standard deviation of 1.2[12]. Thus, the sample size calculation resulted in the need for 20 patients in each group.

Material

In this retrospective study, the sample consisted of 40 patients, 19 women (47.5%) and 21 men (52.5%), with completed orthodontic treatment who already have all the initial and final documentation, including cone beam computed tomography (CBCT). The sample was divided into two groups: group 1 - 20 patients, 7 women and 13 men, with an initial mean age of 23.75 $\pm$ 4.03 and final age mean 26.87 $\pm$ 4.09, treated with Damon system using conventional bonding; group 2 - 20 patients, 12 women and 8 men, with an initial mean age of 28.11 $\pm$ 9.66 and final age mean 30.62 $\pm$ 10.46, treated with Damon system using “Smile Arc” bonding.

Eighty CBCT images, 40 pretreatment and 40 posttreatment were evaluated. Initial and final dental inclinations and dental arches dimensions were evaluated, and compared between these two groups.

Inclusion criteria

- Patients with Angle Class I or Class II malocclusions
- Presence of all permanent teeth up to the first molar
- Absence of craniofacial anomalies
- Presence of initial and final orthodontic documentation
- Individuals treated with Damon system self-ligating fixed appliance
- Patients with absence of periodontal disease, agenesis or tooth loss.

Methods

Dental inclination analysis

The buccal and lingual inclinations of the teeth were evaluated using cone beam computed tomography (CBCT) images, in the initial phase (T1) and final phase (T2), through the measurement formed by the angle formed between the long axis (Line that passes through the tip of the cusp vestibular (midpoint) and apical point (Ap) of each upper or lower tooth) and their respective occlusal planes (Fig. 1).

Arches dimensions analysis

The dimensions of the arches, that is, Intercanine widths, Interpremolar 1 (distance between the first homologous premolars), Interpremolar 2 (distance between the homologous second premolars) and Intermolar 1 (distance between the first molars) (homologous) were evaluated by measuring the transverse distances between contralateral teeth, considering the tips of single, buccal or mesiobuccal cusps, for canines, premolars and molars, respectively, using cone beam computed tomography images, in the initial (T1) and final (T2) phases (Fig. 2).

Image evaluation method

The measurements of the images obtained by cone beam computed tomography images, in the initial (T1) and final (T2) phases, will be performed in the Dolphin 3D software (Dolphin Imaging and Management Solutions, Chatsworth, CA, USA). The position of the head image was standardized, and then the cuts were measured and selected. In the median sagittal plane, the patient's occlusal plane must coincide with the horizontal reference line. In the frontal view, the front-maxillary inter-suture line must coincide with the horizontal reference line and in the axial plane, the line that passes through the incisor foramen and posterior nasal spine must coincide with the vertical reference line.

Error Study

The intraexaminer reliability was assessed by the intraclass correlation coefficient (ICC)[13]. After a month interval, 24 CBCT scans were re-measured, and the 2 measurements were compared.

STATISTICAL ANALYSIS

The normality of data was checked with Shapiro-wilk test.

Intergroup comparability of initial and final ages, treatment time and Little irregularity index was performed with independent t tests and sex distribution was performed with chi-square test.

Intergroup comparison of the dental inclination and arch dimensions was performed with independent t test.

Statistical analysis was performed with Statistica software (Statistica for Windows, version 12.0, Statsoft, Tulsa, Okla, USA) and the results were considered significant for $p<0.05$.

RESULTS

Intraclass correlation coefficients (ICCs) varied from 0.85 to 0.94, indicating excellent intra-rater agreement[14].

Chi square test showed that the two groups were not significantly different in terms of sex distribution ($P = 0.113$). There was no significant distinction in the mean initial age and mean final age between the groups ($P = 0.098$ and $P = 0.144$, respectively). The intergroup comparability of the treatment time, independent t-test showed no statistically significant differences ($P = 0.107$).

Regarding the intergroup comparability of the mandibular Little irregularity index and maxillary Little irregularity index analysis, the independent t-test showed no statistically significant differences ($P = 0.149$ and $P = 0.792$, respectively) (Table I).

The intergroup comparison of the dental inclination at the initial stage (T1), the conventional group was presenting statistically significantly greater dental inclination than the smiler arc group, at the maxilla in the canines and incisors, at the mandible in the canines and left first premolar, and all other dental inclinations were greater in the conventional group but statistically non-significant (Table II).

Already the intergroup comparison of the initial arch dimensions, the smile arc group showed a smaller arch width than the conventional group, at the mandible, in the first intermolar, second and first interpremolar and intercanine width and at the maxilla in the intercanine width, however statistically non-significant. In the maxillary first and second interpremolar and first intermolar width, the simile arc group showed a greater than the conventional group, although statistically non-significant (Table III).

In the final stage (T2), after the end of orthodontic treatment and after removal of the orthodontic appliance, the dental buccal inclinations of both groups increased in relation to the initial stage, except for the mandibular molars in the smile arc group, and the intergroup comparison the conventional group presented a statistical significantly greater increase of dental buccal inclinations than the smile arc group, at the maxilla in the bilateral first and second premolars, canines and incisors, at the mandible in the bilateral molars, second premolars and lateral and central incisors, left

canine and left first premolar. The remaining dental inclinations were also greater in the conventional group, although statistically non-significant (Table IV).

There was an increase in arch dimensions in both groups, although the smile arc group showed statistically significantly smaller arch dimensions than the conventional group, in the intergroup comparison, at the mandible, in the first intermolar, first and second interpremolar and intercanine width and at the maxilla in the first interpremolar and intercanine width. The maxillary first intermolar and second interpremolar width were also smaller in the smile arc group, however statistically non-significant (Table V).

In the intergroup comparison of the changes that occurred during treatment (T2-T1), dental inclinations were analyzed and it was noticed that the smile arc group presented buccal inclinations of the right maxillary canine, right and left mandibular canines statistical significantly higher than the conventional group. On the other hand, another 17 of the 24 evaluated dental inclinations, the smile arc group presented smaller dental inclination than the conventional group. Although, only in 6 of the 17 dental inclinations, including the maxillary lateral incisors, there were statistical differences (Table VI).

The treatment changes occurred in relationship of the arch dimensions in the intergroup comparison, the conventional group presented a greater increase in all the measures analyzed than smile arc group, and in 5 of the 8 analyzed arch widths there were statistically significant differences, in the maxillary first intermolar, second and first interpremolar, in the mandibular second and first interpremolar. Only 3 arch widths measures, showed no statistically significant difference: the upper and lower intercanine and lower intermolar distances (Table VII).

DISCUSSION

The main purpose of this study was to assess the effects, on the maxillary and mandibular dental inclination and arch dimensions, with the use of Damon passive self-ligating appliance, comparing two different bracket bonding protocols, in a no-extractions approach. Both groups used the same bracket, Damon 3MX, with the same wire sequence: .014"cuniti, .014X.025"cuniti, .018X.025cuniti and .019X.025" steel.

Our study was retrospective since the two self-ligating samples was previously treated. Thus, in a retrospectively designed study, intergroup compatibility is very important to avoid the influence of other factors on the results.

The conventional protocol for bracket positioning is the method positions each bracket with its center close to the center of the clinical crown, as recommended by Andrews.[2]

The “Smile Arc” protocol is the method for bracket positioning that follow an exacting bracket placement to protect or enhance the smile and align buccal segment cusp tips and marginal ridges. The upper incisor brackets are generally placed more gingivally than the canine brackets. The lower posterior brackets are placed somewhat gingivally to avoid occlusion, while the lower anterior brackets are placed somewhat incisally to optimize overbite.[15]

In this study, in relation to dental inclinations, there was an increase in buccal inclinations in both groups, which is in agreement with the authors of studies that evaluated the incisor's position after the relief of crowding using the Damon System.[16-18]

The intergroup comparison of the treatment changes that occurred between phases (T2-T1), the conventional group showed a greater buccal inclination, especially in the upper laterals incisor region, which is statistically larger than in the Smile Arc group (Table VI), probably due to the smile arc protocol using a more gingivally bonding than in traditional technique, which provides an uprighting of the anterior teeth.[15]

Regarding to the mean of the buccal inclinations of the maxillary right incisor and the maxillary left canines have been greater, even not statistically significant, in the Smile Arc group (Table VI), and the buccal inclinations of the maxillary right canine and mandible right and left canines, significantly greater than the conventional group, it probably may have occurred due to an initial buccal inclination of this teeth, exaggeratedly higher in the conventional group than the smile arc group (Table II).

Regarding the arch dimensions, in both groups, there was an increase in all analyzed inter-distances (Tables III and V), although the conventional group recorded the greatest increases in arch dimensions, with these greatest increases in maxillary and mandibular first and second interpremolar distances (Table VII). This probably must have occurred due to a greater buccal dental inclination registered in the conventional group at the end of the treatment.

These results are in agreement with studies that evaluated arch changes, comparing the Damon system with another type of treatment, stating that the largest transverse changes were observed in the premolars regions and part due to the increase in dental inclinations.[16,17,19-22]

CONCLUSIONS

This study showed that in the Damon system, using two different types of bracket bonding protocols, there are differences between them, in dental inclination and arch dimensions. Whereas the conventional bonding group showed, in general, a greater buccal dental inclination and a larger transversal increase in the arch dimensions.

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FIGURE LEGENDS

Fig.1 – Schematic representation of the measurement of dental inclination, in the selected sagittal section.

Fig. 2 – Schematic drawing showing the method of measuring the widths of the arches used in the analysis of the 3D model. Redesigned by Franchiet al., 2006.[23]

Fig.1

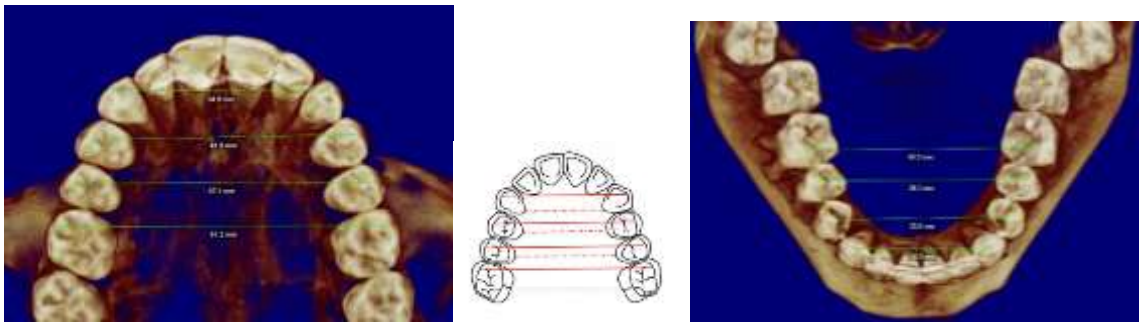

Fig. 2

Table I. Intergroup comparability of initial and final ages, treatment time, Little irregularity index and sex distribution.

Variables	**SMILE ARC (n=20)**	**CONVENTIONAL (n=20)**	**P**
	Mean (SD)	**Mean (SD)**	
Initial Age (years)	28.11 (9.66)	23.75 (4.03)	0.098 [T]
Final Age (years)	30.62 (10.46)	26.87 (4.09)	0.144 [T]
Treatment time (years)	2.51 (1.09)	3.12 (1.24)	0.107 [T]
Mx Little irregularity index (mm)	6.92 (5.26)	7.27 (2.66)	0.792 [T]
Md Little irregularity index (mm)	3.95 (2.98)	5.13 (1.99)	0.149 [T]
Sex			X^2 =2.51
Male	8	13	DF=1
Female	12	7	p=0.113 [α]

[T] independent t-test; [α] chi-square test

Table II. Intergroup comparison of the dental inclination at the initial stage (T1) (independent t test).

Variables (°)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
16	2.27	7.03	3.21	5.31	0.640
15	8.35	7.43	10.15	6.29	0.412
14	6.24	8.09	9.89	4.56	0.097
13	14.59	5.86	26.63	7.33	0.000*
12	22.58	6.79	28.18	6.91	0.014*
11	20.24	9.35	29.49	7.07	0.001*
21	21.67	9.53	28.85	6.59	0.009*
22	24.52	6.45	29.78	6.01	0.011*
23	16.37	5.58	26.04	7.48	0.000*
24	7.80	7.15	10.65	5.29	0.173
25	9.94	6.11	9.63	9.19	0.900
26	2.79	5.05	5.70	4.97	0.075
36	-4.95	5.40	-1.48	5.33	0.051
35	4.84	5.10	7.66	4.77	0.083
34	7.01	6.46	12.02	4.84	0.010*
33	16.79	6.51	25.98	7.16	0.000*
32	22.55	7.87	25.10	5.88	0.254
31	25.49	10.45	28.14	5.77	0.327
41	24.55	11.08	26.16	5.86	0.570
42	22.14	8.55	24.50	8.21	0.379
43	15.08	7.40	25.01	5.02	0.000*
44	10.04	5.23	11.19	5.23	0.512
45	5.64	4.76	3.93	6.43	0.353
46	-4.82	4.73	-3.96	5.72	0.618

* Statistically significant at $p<0.05$

Table III. Intergroup comparison of the arch dimensions at the initial stage (T1) (independent t test).

Variables (mm)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
U6-6	49.63	4.70	49.31	3.03	0.808
U5-5	45.21	4.02	44.58	3.84	0.631
U4-4	40.57	3.13	40.41	2.05	0.848
U3-3	33.10	2.52	34.25	2.26	0.148
L6-6	43.18	3.75	44.31	3.93	0.371
L5-5	37.85	3.08	38.47	3.75	0.579
L4-4	32.22	2.00	32.83	2.92	0.474
L3-3	24.93	1.43	25.75	2.11	0.159

* Statistically significant at $p<0.05$. U – Upper, L – Lower.

Table IV. Intergroup comparison of the dental inclination at the final stage (T2) (independent t test).

Variables (°)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
16	4.32	5.06	6.08	4.02	0.234
15	10.05	5.39	13.87	4.57	0.020*
14	10.79	4.28	14.30	4.08	0.017*
13	18.30	2.70	24.61	4.44	0.000*
12	24.33	4.92	35.02	4.30	0.000*
11	25.56	5.46	34.57	2.65	0.000*
21	26.21	5.67	35.62	3.28	0.000*
22	25.56	5.28	36.02	4.28	0.000*
23	18.02	3.94	26.01	4.51	0.000*
24	10.93	5.70	17.16	4.69	0.001*
25	11.57	4.75	16.89	3.64	0.000*
26	4.82	4.66	6.83	3.48	0.130
36	-6.90	4.77	-0.56	4.77	0.000*
35	6.69	3.76	10.11	4.60	0.016*
34	13.80	4.33	17.13	3.86	0.017*
33	21.06	6.02	24.61	4.39	0.040*
32	27.10	6.45	32.63	4.38	0.003*
31	28.32	7.01	33.87	4.57	0.005*
41	26.73	7.48	32.28	4.14	0.006*
42	24.81	7.56	31.69	4.13	0.001*
43	21.16	7.87	23.46	4.12	0.253
44	13.55	5.76	15.71	3.84	0.182
45	5.49	5.61	8.74	4.16	0.047*
46	-5.84	4.78	-2.44	5.05	0.040*

* Statistically significant at $p<0.05$

Table V. Intergroup comparison of the arch dimensions at the final stage (T2) (independent t test).

Variables (mm)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
U6-6	51.63	4.25	52.49	2.54	0.459
U5-5	47.43	3.36	48.76	2.56	0.183
U4-4	42.22	2.43	43.74	1.77	0.035*
U3-3	34.09	2.11	36.02	1.39	0.002*
L6-6	44.77	2.90	46.69	2.59	0.038*
L5-5	39.56	2.76	42.24	2.02	0.001*
L4-4	34.08	1.84	36.04	1.83	0.003*
L3-3	25.95	1.84	27.78	1.55	0.002*

* Statistically significant at $p<0.05$. U – Upper, L – Lower.

Table VI. Intergroup comparison of treatment changes (T2-T1) of the dental inclination (independent t test).

Variables (°)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
16	1.95	5.82	2.88	3.91	0.556
15	1.70	6.21	3.72	6.05	0.304
14	3.64	6.56	4.41	4.52	0.666
13	4.26	6.07	-2.02	6.28	0.003*
12	1.75	8.54	6.84	6.88	0.045*
11	5.32	8.32	5.08	6.22	0.917
21	4.55	8.37	6.77	5.86	0.337
22	1.04	6.97	6.24	5.64	0.013*
23	1.66	5.64	-0.03	7.30	0.418
24	2.66	5.54	6.51	5.37	0.032*
25	1.63	5.13	6.90	9.27	0.032*
26	2.03	5.37	1.14	4.18	0.562
36	-1.86	4.55	0.92	4.04	0.048*
35	1.76	5.78	2.45	4.33	0.674
34	6.11	7.68	5.11	4.52	0.617
33	4.27	4.39	-1.38	8.16	0.010*
32	4.55	6.18	7.54	6.74	0.152
31	2.83	6.81	5.74	6.31	0.170
41	2.18	6.94	6.12	6.13	0.065
42	2.68	7.11	7.20	8.20	0.070
43	6.08	4.40	-1.55	6.27	0.000*
44	2.98	5.31	4.53	4.27	0.317
45	-0.14	5.09	4.81	6.39	0.010*
46	-0.92	4.12	1.52	5.92	0.139

* Statistically significant at $p<0.05$

Table VII. Intergroup comparison of treatment changes (T2-T1) of the arch dimensions (independent t test).

Variables (mm)	SMILE ARC (n=20)		CONVENTIONAL (n=20)		P
	Mean	SD	Mean	SD	
U6-6	1.81	1.52	3.02	1.50	0.015*
U5-5	2.00	1.91	3.97	2.64	0.010*
U4-4	1.40	2.14	3.33	1.74	0.003*
U3-3	0.89	1.44	1.77	1.87	0.104
L6-6	1.43	1.99	2.38	2.94	0.239
L5-5	1.63	2.56	3.77	2.79	0.015*
L4-4	1.58	2.27	3.21	2.50	0.036*
L3-3	1.02	2.21	2.03	1.83	0.122

* Statistically significant at $p<0.05$. U – Upper, L – Lower.

3 DISCUSSION

3 DISCUSSION

The main purpose of this study was to assess the effects of the use Damon® system passive self-ligating appliance, comparing two different bracket bonding protocols, in a no-extractions approach, on the smile attractiveness, dental inclination and arch dimensions. Both groups used the same bracket, Damon 3MX, with the same wire sequence: .014"cuniti, .014X.025"cuniti, .018X.025cuniti and .019X.025" steel.

The conventional protocol for bracket positioning is the bracket positions method with its center close to the center of the clinical crown, as recommended by Andrews.[10]

The “Smile Arc” protocol is the method for bracket positioning that follows an exacting bracket placement to protect or enhance the smile and align buccal segment cusp tips and marginal ridges. The upper incisor brackets are generally placed more gingivally than the canine brackets. The lower posterior brackets are placed somewhat gingivally to avoid occlusion, while the lower anterior brackets are placed somewhat incisally to optimize overbite.[21]

Our study was retrospective since the two self-ligating samples were previously treated. Thus, in a retrospectively designed study, intergroup compatibility is very important to avoid the influence of other factors on the results.

There was concern in selecting comparable groups according to the amount of initial crowding, sex distribution, to reduce the factors that could influence judgment of smile attractiveness (Table I). This fact is very important because aged smiles undergo several changes, such as a decrease in exposure of the maxillary incisors, greater exposure of the mandibular incisor, the smile gets narrower vertically and there is a decrease in the upper lip thickness.[22]

The results of this study showed that the smile arc bonding group had a wider smile, with a statistically significant greater increase in the smile index, in contrast to the conventional bonding group showed a lower smile exposure with a statistically significant decrease in the interlabial distance (Table II).

Despite this finding, in the intergroup comparison of the changes that occurred between the phases (T2-T1), no significant differences were observed in the smile width, maxillary intercanine width, buccal corridor, interlabial distance and smile index (Table III). Some studies corroborate our findings, where variables such as buccal corridor and smile width do not seem to present significant differences between the different types of orthodontic treatment protocols.[23,24]

Regarding the smile attractiveness judgment, this study showed that there is a significant difference in the intergroup comparison, with the Smile Arc bonding group being statistically significantly better qualified than the conventional bonding group (Table V). And when comparing the 3 groups of evaluators: orthodontists, dentists and laypeople, there was a better assessment of the smile attractiveness for the Smile Arc group, being that, the dentist group gave higher overall ratings statistically significantly for the Smile Arc group. In contrast to these findings, some previous studies that assessed smile attractiveness in different groups of raters concluded that there was no difference in the perceptions of dental professionals and laypeople.[25-31] In the present study, laypeople gave lower scores to the smile attractiveness than the orthodontists and dentists, which is in agreement with the finding described in the literature (Table VI).[24,32,33]

This could probably be because the group of dentists is older (Table IV), so the greater number of years in the clinical practice, it could significantly affect the visualization and judgment of the attractiveness of smiles.[32]

The fact that there are many individual variables in both groups such as muscle factors, tooth inclination and different amounts of crowding is not a surprise. The findings of this study indicate that the buccal corridor and the smile display, represented by the smile index, are probably not affected by the two types of orthodontic bonding analyzed. On the other hand, in the evaluations of real clinical photographs, there were significant differences between laypersons, orthodontists and dentists in their preferences for the attractiveness of the smile achieved with the “Smile Arc” orthodontic bonding.[24,32]

In this study, in relation to dental inclinations, there was an increase in buccal inclinations in both groups, which is in agreement with the authors of studies that

evaluated the incisor's position after the relief of crowding using the Damon System.[34-36]

The intergroup comparison of the treatment changes that occurred between phases (T2-T1), the conventional group showed a greater buccal inclination, especially in the upper laterals incisor region, which is statistically larger than in the Smile Arc group (Table VI), probably due to the smile arc protocol using a more gingivally bonding than in traditional technique, which provides an uprighting of the anterior teeth.[21]

Regarding to the mean of the buccal inclinations of the maxillary right incisor and the maxillary left canines have been greater, even not statistically significant, in the Smile Arc group (Table VI), and the buccal inclinations of the maxillary right canine and mandible right and left canines, significantly greater than the conventional group, it probably may have occurred due to an initial buccal inclination of this teeth, exaggeratedly higher in the conventional group than the smile arc group (Table II).

Regarding the arch dimensions, in both groups, there was an increase in all analyzed inter-distances (Tables III and V), although the conventional group recorded the greatest increases in arch dimensions, with these greatest increases in maxillary and mandibular first and second interpremolar distances (Table VII). This probably must have occurred due to a greater buccal dental inclination registered in the conventional group at the end of the treatment.

These results are in agreement with studies that evaluated arch changes, comparing the Damon system with another type of treatment, stating that the largest transverse changes were observed in the premolars regions and part due to the increase in dental inclinations.[34,35,37-40]

4 FINAL CONSIDERATIONS

4 FINAL CONSIDERATIONS

There was no interference of the two types of orthodontic bonding analyzed in the buccal corridor and smile index.

There was a statistically significant difference in the perception of smile attractiveness by orthodontists, dentists and laypeople, which considered the highest rating for the “Smile Arc” bonding group.

This study showed that in the Damon system, using two different types of bracket bonding protocols, there are differences between them, in dental inclination and arch dimensions. Whereas the conventional bonding group showed, in general, a greater buccal dental inclination and a larger transversal increase in the arch dimensions.

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ANNEXES

ANNEXES

ANNEX A – Research Institutional Board approval, protocol number 24540619.8.0000.5417

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PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Comparação da atratividade do sorriso, inclinações dentarias, espessuras ósseas e dimensões dos arcos dentários em pacientes tratados com aparelho autoligável, no sistema Damon, com colagem convencional e ¿Smile Arc¿

Pesquisador: Marcelo Soares Correa

Área Temática:

Versão: 2

CAAE: 24540619.8.0000.5417

Instituição Proponente: Universidade de Sao Paulo

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 3.959.613

Apresentação do Projeto:

Esse projeto retorna após ser solicitado aos pesquisadores que identificassem a data em que os pacientes teriam sido atendidos para o tratamento ortodôntico.

Objetivo da Pesquisa:

O objetivo principal deste trabalho será avaliar a atratividade do sorriso, as inclinações dentárias, espessuras ósseas e dimensões dos arcos dentários de pacientes tratados pelo Sistema Damon, utilizando duas diferentes colagens ortodônticas: convencional e "Smile Arc Protetion". Secundariamente serão avaliadas a influência das variáveis: corredor bucal, arco do sorriso, exposição gengival, e suas influências na atratividade do sorriso.A amostra de caráter retrospectivo será composta de 40 pacientes com tratamento ortodôntico finalizado que já possuem toda documentação inicial e final, incluindo as tomografias computadorizadas e fotografias do sorriso, coletada entre os anos de 2010 e 2016. A amostra será dividida em dois grupos: grupo 1 - 20 pacientes tratados com sistema Damon utilizando colagem convencional, advindos do arquivo da disciplina de Ortodontia da Faculdade de Odontologia de Bauru-USP e grupo 2 – 20 pacientes tratados com sistema Damon utilizando colagem "Smile Arc", pelo mesmo profissional (M.S.C.), em

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consultório particular na cidade de Campo Belo-MG.
Serão avaliadas 80 fotografias frontais do sorriso posado (Figura 1), 40 fotografias iniciais e 40 finais, destes pacientes para comparar a atratividade do sorriso entre os dois grupos e serão avaliados também as inclinações dentárias, as espessuras ósseas e as dimensões dos arcos dentários por meio de tomografia computadorizada de feixe cônico, e comparadas entre esses dois grupos.

Avaliação dos Riscos e Benefícios:
O risco que existe é uma possível danificação do acervo fotográfico.

Comentários e Considerações sobre a Pesquisa:
NÃO SE APLICA.

Considerações sobre os Termos de apresentação obrigatória:
TCLE apresentado de forma clara e concisa.

Recomendações:
Sem recomendações.

Conclusões ou Pendências e Lista de Inadequações:
Os pesquisadores providenciaram a documentação em pendência assim como atualizaram o cronograma. Recomendo a APROVAÇÃO do projeto por esse CEP.

Considerações Finais a critério do CEP:
Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 01/04/2020, por e-mail, devido à pandemia da COVID-19 e por orientações da CONEP, com base nas normas éticas da Resolução CNS 466/12. Ao término da pesquisa o CEP-FOB/USP exige a apresentação de relatório final. Os relatórios parciais deverão estar de acordo com o cronograma e/ou parecer emitido pelo CEP. Alterações na metodologia, título, inclusão ou exclusão de autores, cronograma e quaisquer outras mudanças que sejam significativas deverão ser previamente comunicadas a este CEP sob risco de não aprovação do relatório final. Quando da apresentação deste, deverão ser incluídos todos os TCLEs e/ou termos de doação assinados e rubricados, se pertinentes.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações	PB_INFORMAÇÕES_BÁSICAS_DO_P	11/03/2020		Aceito

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Continuação do Parecer: 3.959.613

Básicas do Projeto	ETO_1395252.pdf	16:19:13		Aceito
Projeto Detalhado / Brochura Investigador	Projeto_MSC_USP_4_Formatado_CEP_MSC_2.pdf	11/03/2020 16:18:03	Marcelo Soares Correa	Aceito
Recurso Anexado pelo Pesquisador	CARTA_RESPOSTA_AO_CEP_Ass.pdf	11/03/2020 15:20:55	Marcelo Soares Correa	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_Projeto_CEP_Marcelo.pdf	03/12/2019 11:53:31	Marcelo Soares Correa	Aceito
Outros	Oficio_Projeto_CEP_Marcelo_Ass.pdf	03/12/2019 11:52:40	Marcelo Soares Correa	Aceito
Outros	Projeto_MSC_USP_4_Formatado_CEP_MSC_1.pdf	03/12/2019 11:49:58	Marcelo Soares Correa	Aceito
Outros	Check_List_Ass.pdf	02/10/2019 18:08:32	Marcelo Soares Correa	Aceito
Folha de Rosto	FOLHA_DE_ROSTO_Assinada.pdf	23/09/2019 10:19:55	Marcelo Soares Correa	Aceito
Declaração de Instituição e Infraestrutura	Informacao_Sobre_Infraestrutura_MSC.pdf	15/09/2019 13:05:36	Marcelo Soares Correa	Aceito
Outros	Termo_uso_do_arquivo_CB_MSC.pdf	15/09/2019 12:29:12	Marcelo Soares Correa	Aceito
Outros	Termo_uso_do_arquivo_FOB_MSC.pdf	15/09/2019 12:28:26	Marcelo Soares Correa	Aceito
Outros	Termo_de_Confidencialidade_MSC.pdf	15/09/2019 12:26:12	Marcelo Soares Correa	Aceito
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Declaração de Pesquisadores	DeclaracaoCompromissoPesquisadorResultadosPesquisa_MSC.pdf	15/09/2019 12:17:29	Marcelo Soares Correa	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	DispensaTCLE_e_TermoAssentimento_MSC.pdf	15/09/2019 12:15:12	Marcelo Soares Correa	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
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Continuação do Parecer: 3.959.613

BAURU, 07 de Abril de 2020

Assinado por:
Juliana Fraga Soares Bombonatti
(Coordenador(a))

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ANNEX B – Guidelines for AJO-DO submissions: Original Article

AMERICAN JOURNAL OF ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS

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

AUTHOR INFORMATION PACK

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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, color photographs, 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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ABSTRACTING AND INDEXING

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All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Research Council's Guide for the Care

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