UNIVERSIDADE DE SÃO PAULO

FACULDADE DE ODONTOLOGIA DE BAURU

CINTHYA QUAGLIATO NOGUEIRA

Orthodontic treatment of anterior open bite: Comparison of profile and smile attractiveness in patients treated with surgical and compensatory protocols

Tratamento da mordida aberta anterior: Comparação da atratividade do sorriso e perfil em pacientes tratados com protocolo cirúrgico e compensatório

BAURU

2022

CINTHYA QUAGLIATO NOGUEIRA

Orthodontic treatment of anterior open bite: comparison of profile and smile attractiveness in patients treated with surgical and compensatory protocols

Tratamento da mordida aberta anterior: comparação da atratividade do sorriso e perfil em pacientes tratados com protocolo cirúrgico e compensatório

Tese constituída por artigo 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

BAURU

2022

Nogueira, Cinthya Quagliato

Orthodontic treatment of anterior open bite: comparison of profile and smile attractiveness in patients treated with surgical and compensatory protocols / Cinthya Quagliato Nogueira. – Bauru, 2022.

81p., il., 31cm.

Tese (Doutorado) – Faculdade de Odontologia de Bauru. Universidade de São Paulo

Orientador: Prof. Dr. Marcos Roberto de Freitas

Comitê de Ética da FOB-USP
Registro **CAAE: 29996019.5.0000.5417**
Data: **01 de Abril de 2020**

Universidade de São Paulo
Faculdade de Odontologia de Bauru
Assistência Técnica Acadêmica
Serviço de Pós-Graduação

ANOS
FOB-USP
• 1962 - 2022 •

FOLHA DE APROVAÇÃO

Tese apresentada e defendida por
CINTHYA QUAGLIATO NOGUEIRA
e aprovada pela Comissão Julgadora
em 22 de março de 2022.

Prof. Dr. **MURILO MATIAS**
UNG

Prof.ª Dr.ª **MAYARA PAIM PATEL**
UNG

Prof. Dr. **JOSE FERNANDO CASTANHA HENRIQUES**
FOB-USP

Prof. Dr. **MARCOS ROBERTO DE FREITAS**
Presidente da Banca
FOB - USP

Prof. Dr. Marco Antonio Hungaro Duarte
Presidente da Comissão de Pós-Graduação
FOB-USP

DEDICATÓRIA

Dedico esse trabalho, com todo meu amor, à minha família, que me concedeu apoio incondicional durante todo esse período.

Obrigada por apoiar minhas escolhas, por acreditar em mim muitas vezes até mais que eu mesma, por entender minha ausência, e obrigada por ser o lugar que eu sempre terei para voltar!

AGRADECIMENTOS

À Deus, por todas as bênçãos concedidas em minha vida, da minha família e de todos que me cercam. Eu percebo todos os dias o cuidado que o Senhor tem com minha vida e meu futuro, e esta conquista é mais um exemplo do tamanho do meu privilégio. Obrigada pela realização de mais um sonho realizado, por cada oportunidade, pelas pessoas que colocaste em meu caminho e me ajudaram a seguir. Obrigada por nunca me deixar perder a fé e de sempre provar o Teu amor por mim!

Aos meus pais, Soraya e David. Mamãe, obrigada por ter proporcionado uma vida de amor, carinho, dedicação e principalmente, paciência. A senhora sempre será a primeira cirurgiã-dentista que admirei e que me inspirou a seguir estes passos! Papai, obrigada por nunca medir esforços para realizar meus sonhos e apoiar todos os meus objetivos. Eu sou uma pessoa abençoada por todo o incentivo incondicional e tê-lo presente em todas as fases da vida. Amo vocês!

À minha irmã Isabella, "menine", amiga e confidente, que me inspira a fazer um mundo melhor! Tenho muito orgulho da pessoa que você é e de te ter como minha primeira amiga da vida.

À minha irmã Ana Catarina, "Cacá", por todo amor e carinho!

À Ana Verônica, pelo apoio e companheirismo de sempre!

À toda minha família de Jaú, pela torcida e pelos momentos compartilhados. Nossos reencontros foram uma parte muito especial desses últimos anos e fico feliz em ter tido a chance de revê-los.

Um agradecimento especial aos meus avós Renato e Augusta, que tiveram um papel importantíssimo durante a minha

caminhada desde o início da Especialização até o fim do Doutorado. Tê-los perto de mim fez esse período mais que especial, e acho que nunca saberão o quão importante foi poder passar mais tempo com vocês. Obrigada por cada almoço, cada tarde de domingo, pelo cuidado e todo o carinho que tornaram Bauru uma casa para mim.

À toda minha família de Fortaleza, pela torcida e orações. Mesmo com a distância, sei que o apoio e felicidade pelas conquistas estarão sempre presentes.

À minha avó e madrinha Nair, por todo o amor, orações e por ter um coração maravilhoso. Sou eternamente grata pelo amor de mãe e amiga que a senhora tem, e por ser um colo para todos que a cercam!

Ao meu orientador, Prof. Dr. Marcos Roberto de Freitas, por todo o conhecimento passado e por ter confiado em mim este trabalho.

Agradecimento especial à minha professora e orientadora Prof. Dra. Karina de Freitas, por toda orientação e ajuda neste trabalho. Obrigada por transmitir tanto conhecimento com tranquilidade, leveza e respeito. Minha sincera gratidão e admiração!

Aos professores do departamento de Ortodontia: Prof. Arnaldo Pinzan, Profª Daniela Garib, Prof. José Fernando Henriques, Prof. Renato Rodrigues de Almeida. Obrigada por todo conhecimento transmitido e por serem exemplos de profissionais de excelência.

Um obrigada aos funcionários do Departamento de Ortodontia: Cléo, Daniel, Flor, Sérgio, Vera, Wagner. Obrigada por toda a ajuda e colaboração!

À toda minha turma que me acompanhou durante o Mestrado e Doutorado, muito obrigada por todo o companheirismo e ajuda durante esses 5 anos!

Aos meus colegas de Especialização, em especial a "miga" Bruna, "migo" Sérgio e "migo" Sek!! Não consigo pensar nessa caminhada sem lembrar de vocês com muito carinho. Obrigada por essa amizade que vai além da Ortodontia, eu já carrego vocês na vida!

Aos amigos dos outros departamentos da FOB, que se fizeram presentes dentro e fora da faculdade. Obrigada por todos os momentos de descontração, desabafo e por toda a amizade!

Aos pacientes da FOB – USP, muito obrigada pela confiança em mim depositada!

À Faculdade de Odontologia de Bauru – Universidade de São Paulo.

E por último e não menos importante, um agradecimento especial ao Dr. Guilherme Janson. Difícil colocar em palavras em como é finalizar este trabalho sem o senhor, justo quem nos educou e nos acompanhou de perto durante todo o Mestrado e Doutorado, sempre nos estimulando a ir além até o fim de sua vida. Não era desta forma que eu imaginei terminar este ciclo, mas o senhor deixou um legado para além da presença física: nós o carregamos a cada paciente atendido, a cada aula ministrada, a cada aluno que orientamos. "O que o Dr. Guilherme faria?" é o que sempre nos

perguntamos quando nos deparamos com alguma dificuldade em nossa vida profissional, e não por acaso, sempre acaba dando tudo certo quando seguimos os seus ensinamentos. Sou muito grata pela oportunidade de ter sido sua aluna até o fim de sua vida.

O presente trabalho foi realizado com o apoio da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Código de Financiamento 001.

ABSTRACT

ABSTRACT

Orthodontic treatment of anterior open bite: Comparison of profile and smile attractiveness in patients treated with surgical and compensatory protocols

Introduction: The treatment of the open bite is not always performed at the ideal stage and when this occurs, there is usually a greater skeletal factor in its composition, which suggests, in many cases, the association of a surgical treatment simultaneously with the orthodontic one or often in a compensatory orthodontic treatment. **Objective**: To evaluate the attractiveness of the smile and profile among the different protocols for treating anterior open bite. **Methods:** 30 patients with previous open bite treated with or without extractions, divided into two groups, according to the treatment performed: G1- Surgical group, composed of 15 patients (9 females; 6 males) with a mean initial age of 20.53 years. years (SD=4.72) treated with fixed appliances and orthognathic surgery for a period of 2.65 years (SD=0.58). G2- Compensatory group, composed of 15 patients (9 females; 7 males), with a mean initial age of 20.01 years (SD=4.17), treated only with fixed appliances for an average period of 2 .55 years (SD=0.87). The attractiveness of the smile and profile was evaluated in black and white photographs of profiles and smiles posed before and after treatment, with a numerical rating scale from 0 to 10, with 0 being the least attractive and 10 being the most attractive of the smile. Intergroup comparison was performed using an independent t test. **Results:** In the final phase, the surgical group presented a more attractive smile and profile than the compensatory group. The surgical group showed greater improvement in smile attractiveness and profile with treatment than the compensatory group. **Conclusion:** Both surgical and compensatory treatments produce equally satisfactory results in terms of esthetics, both for laypersons and dentists.

KEY WORDS: Open bite; Orthodontics; Orthognatic Surgery

RESUMO

RESUMO

Tratamento da mordida aberta anterior: Comparação da atratividade do sorriso e perfil em pacientes tratados com protocolo cirúrgico e compensatório

Introdução: O tratamento da mordida aberta nem sempre é realizado no estágio ideal e quando isso ocorre, geralmente há maior fator esquelético em sua composição, o que sugere, em muitos casos, a associação de um tratamento cirúrgico concomitante ao ortodôntico ou muitas vezes em um tratamento ortodôntico compensatório. **Objetivo:** Avaliar a atratividade do sorriso e perfil entre os diferentes protocolos de tratamento da mordida aberta anterior. **Métodos**: A amostra foi composta por 30 pacientes com mordida aberta prévia tratados com ou sem extrações, divididos em dois grupos, de acordo com o tratamento realizado: G1- Grupo cirúrgico, composto por 15 pacientes (9 do sexo feminino; 6 do sexo masculino) com média de idade inicial de 20,53 anos. anos (DP=4,72) tratados com aparelhos fixos e cirurgia ortognática por um período de 2,65 anos (DP=0,58). G2- Grupo compensatório, composto por 15 pacientes (9 do sexo feminino; 7 do sexo masculino), com média de idade inicial de 20,01 anos (DP=4,17), tratados apenas com aparelhos fixos por um período médio de 2,55 anos (DP=0,87). A atratividade do sorriso e perfil foi avaliada em fotografias em preto e branco de sorrisos posados antes e após o tratamento, com uma escala numérica de classificação de 0 a 10, sendo 0 a menos atraente e 10 a maior atratividade do sorriso. A comparação intergrupos foi realizada com teste t independente. **Resultados**: Na fase final, o grupo cirúrgico apresentou um sorriso e perfil mais atrativo que o grupo compensatório. O grupo cirúrgico apresentou maior melhora da atratividade do sorriso e perfil com o tratamento do que o grupo compensatório. **Conclusão**: Tanto os tratamentos cirúrgicos quanto os compensatórios produzem resultados igualmente satisfatórios em termos de estética, tanto para leigos quanto para cirurgiões-dentistas.

Palavras-chave: Mordida aberta; Cirurgia ortognática; Ortodontia;

LIST OF FIGURES

ARTICLE 1

ARTICLE 2

LIST OF TABLES

ARTICLE 1

ARTICLE 2

TABLE OF CONTENTS

1 INTRODUCTION

1. INTRODUCTION

The correction of anterior open-bite malocclusion in adult patients is a great challenge in orthodontic therapy.(SARVER; WEISSMAN, 1995; SOLANO-HERNÁNDEZ et al., 2013) Facial disharmonies in the vertical plane are more difficult to be treated and less stable, according to their severity, etiology and stage in which treatment is introduced. Anterior open bite in children is usually treated by a combination of orthopedic and orthodontics approaches.(COZZA et al., 2005b; SOLANO-HERNÁNDEZ et al., 2013) But the treatment of the open bite is not always performed at the ideal stage and when this occurs, there is usually a greater skeletal factor in its composition, which suggests, in many cases, the association of a surgical treatment simultaneously with the orthodontic one or often in a compensatory orthodontic treatment.(BARRER, 1974) In general, this malocclusion, in addition to causing changes in the individual's aesthetic aspect, makes it difficult to apprehend and cut food and also impairs phonemes.(MOYERS, 1991)

Difficulties in treating patients with dental and skeletal disorders associated with vertical discrepancies are a consensus in the orthodontic literature.(GARRETT; ARAUJO; BAKER, 2016) Although open bites caused by dental factors are relatively easy to correct and demonstrate favorable results, open bites with skeletal components are generally more difficult to treat with less stable results.(CHUNG et al., 2012) (COZZA et al., 2005c) Environmental factors, including poor neuromuscular function of the lip or tongue, poor tongue posture and airway obstruction can also increase the risk of open bite.(NGAN; FIELDS, 1997; COZZA et al., 2005a; COZZA et al., 2005c; CHUNG et al., 2012)

Anterior open bite cases are very difficult to treat satisfactorily because of their multifactorial etiology and their very high relapse rate. Dependent on the origin of the anterior open bite malocclusion and the patient’s age, there are several treatment possibilities ranging from deterrent appliances, high-pull headgear, fixed appliances with and without extractions to orthognathic surgery, and skeletal anchorage with miniplates or miniscrews.(REICHERT; FIGEL; WINCHESTER, 2014)

The objective of orthognathic treatment is to correct the functional and aesthetic impairments of dentofacial deformities by means of combined orthodontic and surgical efforts.(PATCAS et al., 2019). While patients may

present to an orthognathic clinic for several reasons, improvement of facial appearance constitutes a prime concern.(NURMINEN; PIETILÄ; VINKKA-PUHAKKA, 1999b; NURMINEN; PIETILÄ; VINKKA-PUHAKKA, 1999a; RYAN; BARNARD; CUNNINGHAM, 2012; PATCAS et al., 2017; PATCAS et al., 2019).

In 2017, Patcas investigated factors that motivate patients to seek orthognathic treatment, assessed how confident patients were that they would be satisfied with the outcome of treatment, and explored possible influencing factors.(PATCAS et al., 2017) The results concur with previous investigations which have identified functional and aesthetic factors to be the main reasons for patients undergoing orthognathic treatment.(PATCAS et al., 2017) Function, aesthetics and psycho-social aspects of life have been found to improve after treatment.(PATCAS et al., 2017)

The effects after orthodontic treatment of the open bite, whether in surgical or compensatory treatment, are well defined in the scientific literature.(VALIATHAN et al., 2010; AL MAAITAH; EL SAID; ABU ALHAIJA, 2012; WANG et al., 2012; CHEN et al., 2018) However, there is still a deficiency in the literature regarding the evaluation of the attractiveness of the profile aesthetic changes after orthodontic treatment.

Much research has been devoted to accurately evaluating the aesthetic outcome of orthognathic treatment.(PATCAS et al., 2019) Improvements in facial appearance have been studied based on self-reported scores of patients(HUNT et al., 2001; ISLAM; ALEEM; ORMISTON, 2015; SCHWITZER et al., 2015; PATCAS et al., 2019) or orthodontists and maxillofacial surgeons appraising the changes in soft tissue proportions and facial aesthetics(PATCAS et al., 2019).(JESANI et al., 2014; STORMS et al., 2017) However, all historical approaches fall short of adequately addressing the assessment of social attractiveness(JESANI et al., 2014; PATCAS et al., 2019).

Patcas demonstrated that orthognathic treatment significantly improves facial attractiveness, both in males and females.(PATCAS et al., 2019) Regarding age appearance, people with severe malocclusions looked older than their real age, an observation more accentuated in males.

The facial change following combined orthodontic and surgical treatment of class III malocclusion contributes to the judgment of the personality of an individual.(JESANI et al., 2014) In a study by Jesani, findings support previous

research that suggests poor dental and facial appearance exerts a negative influence on the appraisal of social perception.(SHAW et al., 1985; KEROSUO et al., 1995; ELI; BAR-TAL; KOSTOVETZKI, 2001; KERSHAW; NEWTON; WILLIAMS, 2008; SOMANI et al., 2010; JESANI et al., 2014)

Even though the effectiveness, dentoalveolar and skeletal changes of treatment with compensatory and surgical protocols for treatment of the anterior open bite are well defined through scientific research, there is still a lack of literature when comparing the attractiveness of the profile and smile changes between these different protocols directly among themselves. Therefore, the purpose of this study is to compare the attractiveness of the profile and smile changes between compensatory and surgical treatments of the anterior open bite.

2 ARTICLE 1

2 ARTICLES

The following article presented in this Dissertation was formatted according to the American Journal of Orthodontics and Dentofacial Orthopedics instructions and guidelines for article submission.

Orthodontic treatment of anterior open bite: Comparison of profile attractiveness in patients treated with surgical and compensatory protocols

ABSTRACT

Objective: To evaluate the attractiveness of the profile between the different protocols for treating the anterior open bite. **Methods:** The sample comprised 39 patients with anterior open bite treated with or without extractions, divided into 2 groups: The Surgical group (G1) comprised 21 subjects (10 male, 11 female) with mean initial age of 21.86 years (SD=5.09), treated with fixed orthodontic appliance followed by orthognathic surgery, for a total mean period of 2.53 years (SD=0.61). The mean open bite severity was 4.12mm (SD=1.35). The Compensatory group (G2) comprised 18 subjects (9 male, 9 female), with mean initial age of 20.47 years (SD=4.19), treated only with fixed orthodontic appliance, for a total mean period of 2.56 years (SD=0.94). The mean open bite severity was 3.54mm (SD=1.01). Lateral photographs from pretreatment and posttreatment were used. These photographs were evaluated by 46 laypeople and 67 dentists, who rated the attractiveness of each profile from 0 (most unattractive profile) to 10 (most attractive profile). Intergroup comparisons were performed with independent t tests. **Results:** Before treatment, the profile of the surgical group was significantly less attractive than the profile of the compensatory group. At the final stage, the surgical presented a more attractive profile than the compensatory group. The surgical group presented a greater improvement of the profile attractiveness with treatment than the compensatory group. **Conclusion:** At the final stage, the surgical presented a more attractive and a greater improvement of the profile attractiveness than the compensatory group. The laypeople and dentists judged similarly the initial profile attractiveness.

KEYWORDS: Orthodontics; Open bite malocclusion; Attractiveness; profile.

INTRODUCTION

The correction of anterior open-bite malocclusion in adult patients is a great challenge in orthodontic therapy.[1,2] Facial disharmonies in the vertical plane are more difficult to be treated and less stable, according to their severity, etiology and stage in which treatment is introduced. Anterior open bite in children is usually treated by a combination of orthopedic and orthodontics approaches.[2,3] But the treatment of the open bite is not always performed at the ideal stage and when this occurs, there is usually a greater skeletal factor in its composition, which suggests, in many cases, the association of a surgical treatment simultaneously with the orthodontic one or often in a compensatory orthodontic treatment.[4] In general, this malocclusion, in addition to causing changes in the individual's aesthetic aspect, makes it difficult to apprehend and cut food and also impairs phonemes.[5]

Difficulties in treating patients with dental and skeletal disorders associated with vertical discrepancies are a consensus in the orthodontic literature.[6] Although open bites caused by dental factors are relatively easy to correct and demonstrate favorable results, open bites with skeletal components are generally more difficult to treat with less stable results.[7 8] Environmental factors, including poor neuromuscular function of the lip or tongue, poor tongue posture and airway obstruction can also increase the risk of open bite.[7-10]

Anterior open bite cases are very difficult to treat satisfactorily because of their multifactorial etiology and their very high relapse rate. Dependent on the origin of the anterior open bite malocclusion and the patient’s age, there are several treatment possibilities ranging from deterrent appliances, high-pull headgear, fixed appliances with and without extractions to orthognathic surgery, and skeletal anchorage with miniplates or miniscrews.[11]

The objective of orthognathic treatment is to correct the functional and aesthetic impairments of dentofacial deformities by means of combined orthodontic and surgical efforts.[12]. While patients may present to an orthognathic clinic for several reasons, improvement of facial appearance constitutes a prime concern.[12-16].

In 2017, Patcas investigated factors that motivate patients to seek orthognathic treatment, assessed how confident patients were that they would be satisfied with the outcome of treatment, and explored possible influencing

factors.[14] The results concur with previous investigations which have identified functional and aesthetic factors to be the main reasons for patients undergoing orthognathic treatment.[14] Function, aesthetics and psycho-social aspects of life have been found to improve after treatment.[14]

The effects after orthodontic treatment of the open bite, whether in surgical or compensatory treatment, are well defined in the scientific literature.[17-20] However, there is still a deficiency in the literature regarding the evaluation of the attractiveness of the profile aesthetic changes after orthodontic treatment.

Much research has been devoted to accurately evaluating the aesthetic outcome of orthognathic treatment.[12] Improvements in facial appearance have been studied based on self-reported scores of patients[12,21-23] or orthodontists and maxillofacial surgeons appraising the changes in soft tissue proportions and facial aesthetics[12].[24,25] However, all historical approaches fall short of adequately addressing the assessment of social attractiveness[12,25].

Patcas demonstrated that orthognathic treatment significantly improves facial attractiveness, both in males and females.[12] Regarding age appearance, people with severe malocclusions looked older than their real age, an observation more accentuated in males.

The facial change following combined orthodontic and surgical treatment of class III malocclusion contributes to the judgment of the personality of an individual.[25] In a study by Jesani, findings support previous research that suggests poor dental and facial appearance exerts a negative influence on the appraisal of social perception.[25-30]

Even though the effectiveness, dentoalveolar and skeletal changes of treatment with compensatory and surgical protocols for treatment of the anterior open bite are well defined through scientific research, there is still a lack of literature when comparing the attractiveness of the profile changes between these different protocols directly among themselves. Therefore, the purpose of this study is to compare the attractiveness of the profile changes between compensatory and surgical treatments of the anterior open bite.

MATERIAL AND METHODS

The study was approved by the ethical committee of Bauru Dental School, University of São Paulo, Brazil (protocol number 29996019.5.0000.5417).

The sample size calculation was based on an alpha significance level of 5% and a beta of 20% to achieve 80% of test power to detect a minimum difference of 1 point in the score of profile attractiveness, with a standard deviation of 1.02.[31] This way, the sample size calculation showed the need for at least 17 subjects in each group.

Sample characteristics

Therefore, a retrospective sample of 78 photographs of 39 individuals (21 treated surgically, 18 compensatory treated). Patients were selected from the files of orthodontists' practices in Bauru – SP. The patients were selected according to the following inclusion criteria: adults (> 18 years of age); initial open bite malocclusion; treated with orthognathic surgery, orthodontically treated without extractions or with 2or 4-premolar extractions; initial and final orthodontic records in good conditions. No profile or cephalometric characteristic was considered as inclusion criteria.

Patients were divided into 2 groups according to the treatment protocol: surgical (n=21) and compensatory (n=18).

The Surgical group (Group 1) comprised 21 subjects (10 male, 11 female) at an initial mean age of 21.86 years ± 5.09 years old, treated with fixed orthodontic appliance followed by orthognathic surgery, for a total mean period of 2,53 years ± 0,61. The mean open bite severity was 4.12mm ± 1.35mm. Two patients presented Class I malocclusion, four presented Class II malocclusion and fourteen patients presented Class III malocclusion.

The Compensatory group (Group 2) comprised 18 subjects (9 male, 9 female), at an initial mean age of 20.47 years ± 4.19 years, treated only with fixed orthodontic appliance, for a total mean period of 2.56 years ± 0.94 years. The mean open bite severity was 3.54mm ± 1.01mm. Two patients presented Class I

malocclusion, six presented Class II malocclusion and ten patients presented Class III malocclusion.

Treatment protocol

Treatments were performed with fixed edgewise appliances, with 0.022 x 0.028-inch conventional brackets. Wire sequences including initial 0.016-inch Nitinol, followed by 0.018, 0.020, and 0.018 x 0.025 or 0.019 x 0.025-inch stainless steel archwires (3M Unitek, Monrovia, Calif) were used during treatment. Accentuated and reversed curves of Spee were used to correct deep overbites. In the compensatory group, intermaxillary elastics were used to close the open bite. Patients treated with extractions for overjet and Class II canine correction the anterior teeth were retracted “en masse” with the use of rectangular archwires. In the surgical group, bimaxillary surgeries with maxillary impaction were performed. Depending on the type of malocclusion in the anterior segment, mandibular impaction or maxillary advancement was performed.

Profile evaluation

Lateral photographs were taken of each patient at the pre- (T1) and posttreatment (T2) stages. The photographs were taken by the same investigator with the same camera (Nikon D80 with 100mm macro lens, Nikon, Japan), with the same distance from the camera to the face of the patient, and standardized natural head position and the patient looking forward.[32-34]

The images were cut in PhotoshopCS6 with an 18x13cm template to show only the mouth area. Hair was removed from the profile photographs. Then, the images were changed to black and white to mask any changes that could influence the assessment. All images had 300 dpi resolution and TIF format.

To evaluate the profile attractiveness, two types of evaluators were chosen: laypeople and dentists. In this study, the laypeople were defined as an individual without formal education in dentistry or dental hygiene. The dentists were considered all the dental surgeon with dental degree. Each layman and dentist received a message or email inviting them to participate in the research through a Google Forms link. All data were stored in a database accessible via the internet, only by the researcher.

The profile photographs were evaluated by 46 laypeople and 67 dentists, who rated the attractiveness of each profile by a numerical rating scale from 0 to 10, with 0 being the least attractive and 10 being the most attractive profile. The evaluators were able to view the photographs for as long and as often as they wish and change the responses if necessary. Support and answers to possible questions of the evaluators were provided.

Error Study

To evaluate the precision of the evaluators in rating the profile attractiveness of the questionnaire, two profile photographs were randomly repeated throughout the questions, and the Intraclass correlation coefficient (ICC) was used.[35]

Statistical analysis

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

Intergroup comparability of the initial age, treatment time and initial severity of open bite were performed with independent t tests and sex distribution and type of malocclusion were performed with chi-square test.

Intragroup comparison of the initial and final stages was performed with dependent t tests. Intergroup comparison of the profile attractiveness was performed with independent t tests.

The comparability of the age and sex distribution of the two groups of evaluators was performed with independent t and chi-square tests, respectively. The score of the initial and final profile attractiveness between the two groups of evaluators was compared with independent T tests.

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 precision of the evaluators in rating the profile attractiveness varied from 0.87 to 0.95. These ICCs indicate an excellent intra-rater agreement.[36]

There was comparability of the initial age, treatment time, initial severity of open bite, sex distribution and type of malocclusion (Table I).

In both groups, surgical and compensatory, there was an improvement of the profile attractiveness with treatment (Table II).

Before treatment, the profile of the surgical group was significantly less attractive than the profile of the compensatory group (Table III). At the final stage, the surgical presented a more attractive profile than the compensatory group (Table III). The surgical group presented a greater improvement of the profile attractiveness with treatment than the compensatory group (Table III).

There was comparability of the age and sex distribution of the groups of evaluators (Table IV). The laypeople and dentists judged similarly the initial profile attractiveness (Table V). For the final profile attractiveness, the laypeople were more critical than the dentists (Table V).

DISCUSSION

Previous studies have discussed the profile changes of surgical and compensatory treatments of the open bite malocclusion.[37-40] However, a direct comparison of the treatment changes between these two different protocols has not been reported.

The main focus of this study was to compare the attractiveness effects between surgical and compensatory protocols among themselves and in relation to different evaluators. It was assumed that the best treatment protocol was chosen for each patient at the time they were treated. It was not the aim of this study to investigate whether the treatment protocol applied to each patient was the best option. Therefore, intergroup comparisons of changes during treatment (T1-T2) were not evaluated. Many previous studies have described the effects of these treatments at the posttreatment stage.[39,40] Since facial attractiveness is determined by a set of different facial attributes adequately arranged,[41-43] no specific soft-tissue cephalometric variable was correlated in profile attractiveness in this study.

Methodology

Facial aesthetics concepts can vary widely because it is subjective and personal.[43] To measure facial aesthetics, wide and different groups' opinions

should be considered.[43-45] Therefore, besides the 67 dentists, 46 laypeople from different professional areas were included.

The survey conducted through a website enabled a randomized order of evaluations for each rater.[32] To avoid an exhausting process, they were able to observe the images as many times as they wanted, revise their assessments if necessary, independently, and without time constraints.[31,33]

The 10-point numerical scale[32] provided a simple, non-suggestive method of evaluation, reporting precisely and quantitatively the raters' opinions.[43] Reliability was ensured because no effort was made to guide the evaluation with attractive or unattractive examples.[43,46]

The groups were comparable regarding pretreatment, treatment period, open bite severity, sex distribution and initial malocclusion (Table I). This helps to eliminate confusing variables when discussing treatment results. The type of malocclusion did not influence the results since the two groups had great comparability regarding the type of malocclusion. It was very important that the open bite severity was compatible between and this was accomplished, making both groups and the compatibility between them more reliable.

Facial attractiveness

Both groups showed statistically significant improvement of the profile attractiveness in the posttreatment period (Table II). This was expected since it is known that orthodontic treatment promotes improvement in the sagittal maxillomandibular relationship,[3,40] as it was expected after both surgical[2,47] and compensatory treatment.[3,38,40] The similarity in profile attractiveness among the groups may be consequent to the correct treatment protocol used in each patient.

Whether surgical or compensatory treatment, when correctly indicated, usually improves facial attractiveness.[43,48,49] The main issue is not about the best treatment, but the conditions under which each one is chosen.[43,50]

Before treatment, the profile of the surgical group was significantly less attractive than the profile of the compensatory group (Table III). This is expected since surgical cases are usually more severe not only in the malocclusion severity but also in the profile attractiveness deficiency. The surgical group also presented a more attractive profile than the compensatory group at the final stage (Table III). Because orthognathic surgery works not only with dental corrections but also

with the possibility of completely changing the soft tissue profile, unlike compensatory treatment and its limitations, this was predictable in the evaluation. This could suggest that the surgical treatment of the open bite malocclusion had greater esthetic effects than the compensatory treatment.

The laypeople and dentists judged similarly the initial profile attractiveness (Table V). That has some implications because the present results show that even though laypeople may not be able to differentiate between the morphology of malocclusions, they are perfectly able to categorize them as unaesthetic. This ability to judge an unattractive profile is usually the main motivation for a lay patient to seek orthodontic treatment, even more so surgical treatment.[51]

For the final profile attractiveness, the laypeople were more critical than the dentists, assigning significantly lower scores to the subjects' attractiveness (Table V), likewise previous results.[43,50] These different views may be due to their different ages and sex. Laypeople group, slightly younger than the professional group, might have been less tolerant to what they considered lack of attractiveness. Professional raters, slightly older and quite used to accurate facial analysis, probably valued individual attributes that the lay ones did not. [43,52]

The results of this present study emphasize the importance of taking into account the viewpoint of the patient and ordinary people in the esthetic goals when planning and executing the orthodontic treatment. It was particularly relevant that laypeople appeared to be more judicious when rating a facial profile than general dentists.

Clinical implications

Strategies for open bite malocclusion treatment, whether in surgical or compensatory protocols, should consider important criteria such as facial appearance, malocclusion severity, patient age, available space for third molars, mechanical efficiency, and the challenges offered by each device or treatment protocol.

The similarity in profile attractiveness among the groups may be consequent to the correct treatment protocol used in each patient. Both surgical or compensatory treatment, when correctly indicated, usually improves facial attractiveness.[53] The main issue is not about the best treatment, but the conditions which each one is chosen.[43,50] As laypersons were more critical for the

assessment, it means that they are attentive to the beauty of the face, and we as professionals must be prepared to correctly explain the different treatment modalities and the esthetic effects arising from it, especially in borderline cases.

CONCLUSIONS

Based on this specific study, it can be concluded that:

- At the final stage, the surgical group presented a more attractive and a greater improvement of the profile attractiveness than the compensatory group.
- The laypeople and dentists judged similarly the initial profile attractiveness.
- For the final profile attractiveness, the laypeople were more critical than the dentists.

ACKNOWLEDGEMENT

We thank the Coordination for the Improvement of Higher Education Personnel (CAPES) for the financial support.

Figure legends:

Figure 1: The 10-point numerical scale under each profile photograph and the question about each individual's attractiveness.

0 1 2 3 4 5 6 7 8 9 10

Figure 1: The 10-point numerical scale under each pair of photographs and the question about each individual's apparent age.

Table I. Results of intergroup comparability of initial and final ages, treatment time, initial severity of open bite, sex distribution and type of malocclusion.

Variables	GROUP 1 Surgical n=21	GROUP 2 Compensatory n=18	P
	Mean (SD)	Mean (SD)	
Initial age (years)	21.86 (5.09)	20.47 (4.19)	0.373 [T]
Treatment Time (years)	2.53 (0.61)	2.56 (0.94)	0.919 [T]
Open bite severity (mm)	4.12 (1.35)	3.54 (1.01)	0.143 [T]
Sex			X^2=0.02
Males	10	9	DF=1
Females	11	9	p=0.882 [α]
Type of malocclusion			X^2=1.18
Class I	2	2	DF=2
Class II	4	6	p=0.555 [α]
Class III	15	10	

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

Table II. Results of intragroup comparison of the initial and final profile attractiveness (dependent t test).

Profile attractiveness	Initial (T1)		Final (T2)		p
	Mean	SD	Mean	SD	
Group 1 - Surgical	3.10	2.53	5.25	2.75	**0.000***
Group 2 - Compensatory	3.88	2.49	4.60	2.54	**0.000***

* Statistically significant for p<0.05

Table III. Results of intergroup comparison of the profile attractiveness (independent t test).

Profile attractiveness	GROUP 1 Surgical n=21		GROUP 2 Compensatory n=18		p
	Mean	SD	Mean	SD	
Initial (T1)	3.10	2.53	3.88	2.49	**0.000***
Final (T2)	5.25	2.75	4.60	2.54	**0.000***
Treatment changes (T2-T1)	2.15	3.17	0.72	2.64	**0.000***

* Statistically significant for p<0.05

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

Variables	Laypeople N=46		Dentists N=67		P
	Mean	SD	Mean	SD	
Age (years)	32.83	10.21	34.81	8.98	0.279 [T]
Sex					X^2 =0.18
Female	27		42		DF=1
Male	19		25		p=0.669 [α]

[T] Independent t test
[α] chi-square test

Table V. Comparison of the groups of evaluators (independent t test).

Profile attractiveness	Laypeople N=46		Dentists N=67		P
	Mean	SD	Mean	SD	
Initial (T1)	3.52	2.66	3.41	2.46	0.169
Final (T2)	4.76	2.79	5.08	2.59	**0.000***

* Statistically significant for p<0.05

REFERENCES

1. Sarver DM, Weissman SM. Nonsurgical treatment of open bite in nongrowing patients. American Journal of Orthodontics and Dentofacial Orthopedics 1995;108:651-659.
2. Solano-Hernández B, Antonarakis GS, Scolozzi P, Kiliaridis S. Combined orthodontic and orthognathic surgical treatment for the correction of skeletal anterior open-bite malocclusion: a systematic review on vertical stability. Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons 2013;71:98-109.
3. Cozza P, Mucedero M, Baccetti T, Franchi L. Early orthodontic treatment of skeletal open-bite malocclusion: a systematic review. The Angle orthodontist 2005;75:707-713.
4. Barrer HG. Limitations in orthodontics. Am J Orthod 1974;65:612-625.
5. Moyers RE. Ortodontia. Guanabara Koogan; 1991.
6. Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2016;149:269-276.
7. Chung CJ, Hwang S, Choi YJ, Kim KH. Treatment of skeletal open-bite malocclusion with lymphangioma of the tongue. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2012;141:627-640.
8. Cozza P, Mucedero M, Baccetti T, Franchi L. Early orthodontic treatment of skeletal open-bite malocclusion: a systematic review. The Angle orthodontist 2005;75:707-713.
9. Cozza P, Baccetti T, Franchi L, Mucedero M, Polimeni A. Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2005;128:517-519.
10. Ngan P, Fields HW. Open bite: a review of etiology and management. Pediatric dentistry 1997;19:91-98.
11. Reichert I, Figel P, Winchester L. Orthodontic treatment of anterior open bite: a review article--is surgery always necessary? Oral and maxillofacial surgery 2014;18:271-277.
12. Patcas R, Bernini DAJ, Volokitin A, Agustsson E, Rothe R, Timofte R. Applying artificial intelligence to assess the impact of orthognathic treatment on facial attractiveness and estimated age. International journal of oral and maxillofacial surgery 2019;48:77-83.
13. Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics 1999;21:79-87.
14. Patcas R, Cunningham SJ, Shute J, Lloyd T, Obwegeser JA, Arjomand L et al. Motivation for orthognathic treatment and anticipated satisfaction levels—a two-centre cross-national audit. Journal of Cranio-Maxillofacial Surgery 2017;45:1004-1009.

15. Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics 1999;21:79-87.
16. Ryan FS, Barnard M, Cunningham SJ. Impact of dentofacial deformity and motivation for treatment: A qualitative study. American Journal of Orthodontics and Dentofacial Orthopedics 2012;141:734-742.
17. Al Maaitah E, El Said N, Abu Alhaija ES. First premolar extraction effects on upper airway dimension in bimaxillary proclination patients. The Angle orthodontist 2012;82:853-859.
18. Chen YJ, Chen HH, Hsu LF, Wang SH, Chen YJ, Lai EH et al. Airway increase after open bite closure with temporary anchorage devices for intrusion of the upper posteriors: Evidence from 2D cephalometric measurements and 3D magnetic resonance imaging. Journal of oral rehabilitation 2018;45:939-947.
19. Wang Q, Jia P, Anderson NK, Wang L, Lin J. Changes of pharyngeal airway size and hyoid bone position following orthodontic treatment of Class I bimaxillary protrusion. The Angle orthodontist 2012;82:115-121.
20. Valiathan M, El H, Hans MG, Palomo MJ. Effects of extraction versus non-extraction treatment on oropharyngeal airway volume. The Angle orthodontist 2010;80:1068-1074.
21. Hunt OT, Johnston CD, Hepper PG, Burden DJ. The psychosocial impact of orthognathic surgery: a systematic review. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2001;120:490-497.
22. Schwitzer JA, Albino FP, Mathis RK, Scott AM, Gamble L, Baker SB. Assessing Patient-Reported Outcomes Following Orthognathic Surgery and Osseous Genioplasty. The Journal of craniofacial surgery 2015;26:2293-2298.
23. Islam S, Aleem F, Ormiston IW. Subjective assessment of facial aesthetics after maxillofacial orthognathic surgery for obstructive sleep apnoea. The British journal of oral & maxillofacial surgery 2015;53:235-238.
24. Storms AS, Vansant L, Shaheen E, Coucke W, de Llano-Pérula MC, Jacobs R et al. Three-dimensional aesthetic assessment of class II patients before and after orthognathic surgery and its association with quantitative surgical changes. International journal of oral and maxillofacial surgery 2017;46:1664-1671.
25. Jesani A, DiBiase AT, Cobourne MT, Newton T. Perceived changes by peer group of social impact associated with combined orthodontic-surgical correction of class III malocclusion. Journal of dentistry 2014;42:1135-1142.
26. Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. Am J Orthod 1985;87:21-26.
27. Kerosuo H, Hausen H, Laine T, Shaw WC. The influence of incisal malocclusion on the social attractiveness of young adults in Finland. European journal of orthodontics 1995;17:505-512.
28. Eli I, Bar-Tal Y, Kostovetzki I. At first glance: social meanings of dental appearance. Journal of public health dentistry 2001;61:150-154.
29. Kershaw S, Newton JT, Williams DM. The influence of tooth colour on the perceptions of personal characteristics among female dental patients: comparisons of unmodified, decayed and 'whitened' teeth. British dental journal 2008;204:E9; discussion 256-257.

30. Somani A, Newton JT, Dunne S, Gilbert DB. The impact of visible dental decay on social judgements: comparison of the effects of location and extent of lesion. International dental journal 2010;60:169-174.
31. Mendes LM, Janson G, Zingaretti Junqueira-Mendes CH, Garib DG. Long-term profile attractiveness in Class II Division 1 malocclusion patients treated with and without extractions. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2019;155:362-371.
32. Janson G, Branco NC, Morais JF, Freitas MR. Smile attractiveness in patients with Class II division 1 subdivision malocclusions treated with different tooth extraction protocols. European journal of orthodontics 2011;36:1-8.
33. McNamara L, McNamara JA, Jr., Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2008;133:491-499.
34. Schabel BJ, McNamara Jr JA, Franchi L, Baccetti T. Q-sort assessment vs visual analog scale in the evaluation of smile esthetics. American Journal of Orthodontics and Dentofacial Orthopedics 2009;135:S61-S71.
35. Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychological bulletin 1979;86:420.
36. Enderlein G. Fleiss, JL: The Design and Analysis of Clinical Experiments. Wiley, New York–Chichester–Brislane–Toronto–Singapore 1986, 432 S.,£ 38.35: Wiley Online Library; 1988.
37. Chu YM, Bergeron L, Chen YR. Bimaxillary protrusion: an overview of the surgical-orthodontic treatment. Seminars in plastic surgery 2009;23:32-39.
38. Cruz-Escalante MA, Aliaga-Del Castillo A, Soldevilla L, Janson G, Yatabe M, Zuazola RV. Extreme skeletal open bite correction with vertical elastics. The Angle orthodontist 2017;87:911-923.
39. Cunningham SJ, Johal A. Orthognathic correction of dento-facial discrepancies. British dental journal 2015;218:167-175.
40. Denny JM, Weiskircher MA, Dorminey JC. Anterior open bite and overjet treated with camouflage therapy. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2007;131:670-678.
41. Berto PM, Lima CS, Lenza MA, Faber J. Esthetic effect of orthodontic appliances on a smiling face with and without a missing maxillary first premolar. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2009;135:S55-60.
42. Flores-Mir C, Silva E, Barriga MI, Lagravere MO, Major PW. Lay person's perception of smile aesthetics in dental and facial views. Journal of orthodontics 2004;31:204-209; discussion 201.
43. Janson G, Junqueira CHZ, Mendes LM, Garib DG. Influence of premolar extractions on long-term adult facial aesthetics and apparent age. European journal of orthodontics 2015;38:272-280.

44. Kocadereli I. Changes in soft tissue profile after orthodontic treatment with and without extractions. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2002;122:67-72.
45. Naini FB, Moss JP, Gill DS. The enigma of facial beauty: esthetics, proportions, deformity, and controversy. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2006;130:277-282.
46. Dourado GB, Volpato GH, de Almeida-Pedrin RR, Oltramari PVP, Fernandes TMF, Conti ACdCF. Likert scale vs visual analog scale for assessing facial pleasantness. American Journal of Orthodontics and Dentofacial Orthopedics 2021;160:844-852.
47. Lello GE. Skeletal open bite correction by combined Le Fort I osteotomy and bilateral sagittal split of the mandibular ramus. Journal of Cranio-Maxillofacial Surgery 1987;15:132-136.
48. Lim HJ, Ko KT, Hwang HS. Esthetic impact of premolar extraction and nonextraction treatments on Korean borderline patients. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2008;133:524-531.
49. Boley JC, Pontier JP, Smith S, Fulbright M. Facial changes in extraction and nonextraction patients. The Angle orthodontist 1998;68:539-546.
50. Bowman SJ, Johnston LE, Jr. The esthetic impact of extraction and nonextraction treatments on Caucasian patients. The Angle orthodontist 2000;70:3-10.
51. Bailey L, Haltiwanger L, Blakey G, Proffit W. Who seeks surgical-orthodontic treatment: a current review. Int J Adult Orthodon Orthognath Surg 2001;16:280-292.
52. Tole N, Lajnert V, Kovacevic Pavicic D, Spalj S. Gender, age, and psychosocial context of the perception of facial esthetics. Journal of esthetic and restorative dentistry : official publication of the American Academy of Esthetic Dentistry ... [et al.] 2014;26:119-130.
53. Julie-Heide-Miyazaki Watanabe FF, de Freitas D-S, Cançado R-H. Comparison of the facial profile attractiveness in Class III borderline patients after surgical or compensatory orthodontic treatment. Journal of Clinical and Experimental Dentistry 2020;12:e348.

3 ARTICLE 2

Orthodontic treatment of anterior open bite: Comparison of smile attractiveness in patients treated with surgical and compensatory protocols

ABSTRACT

Objective: To evaluate the smile attractiveness between the different protocols for treating the anterior open bite. **Methods:** The sample consisted of 30 patients with anterior open bite treated with or without extractions divided into two groups, according to the treatment performed: G1- Surgical group, consisting of 15 patients (9 female; 6 male) with mean initial age of 20.53 years (SD=4.72) treated with fixed appliances and orthognathic surgery for a period of was 2.65 years (SD=0.58). The mean open bite severity was 4.33mm (SD=1.28). G2- Compensatory group, consisting of 15 patients (9 female; 7 male), with mean initial age of 20.01 years (SD=4.17), treated only with fixed appliances for a mean period of 2.55 years (SD=0.87). The mean open bite severity was 3.64mm (SD=0.96). The smile attractiveness was evaluated in black and white photographs of posed smiles taken before and after treatment, with a numerical rating scale from 0 to 10, with 0 being the least attractive and 10 the greatest smile attractiveness. The smiles were evaluated in a questionnaire by 116 participants, 53 dentists (mean age 31.70 years, SD=7.80) and 63 laypeople (mean age 36.08 years, SD=12.20). Intergroup comparison was performed with independent t-test. **Results:** In both groups, surgical and compensatory, there was a statistically significant improvement of the smile attractiveness with treatment. The dentists were more critical in the evaluation of the initial smile attractiveness. In the final stage, the laypeople and the dentists judge similar the smile attractiveness. **Conclusion:** Both surgical and compensatory treatments produce equally satisfactory results in terms of smile esthetics, however, at the end of the treatment, the surgical group showed greater attractiveness than the compensatory group.

KEYWORDS: Orthodontics; Open bite malocclusion; Attractiveness; Smile.

INTRODUCTION

In current orthodontic therapy, one of the main objectives is to improve facial aesthetics,[1-3] and one of the facial characteristics that most positively influence attractiveness is the smile.[4] However, facial disharmonies in the vertical plane are more difficult to be treated and less stable, according to their severity, etiology and stage in which treatment is introduced. Among these, one that challenges professionals is the anterior open bite, which should be corrected as early as possible, providing a simpler therapy and a more favorable prognosis. But the treatment is not always performed at the ideal stage and when this occurs, there is usually a greater skeletal factor in its composition, which suggests, in many cases, the association of a surgical treatment simultaneously with the orthodontic one or often in a compensatory orthodontic treatment.[5] In general, this malocclusion, in addition to causing changes in the individual's aesthetic aspect, makes it difficult to apprehend and cut food and also impairs phonemes.[6]

Difficulties in treating patients with dental and skeletal disorders associated with vertical discrepancies are a consensus in the orthodontic literature.[7] Although open bites caused by dental factors are relatively easy to correct and demonstrate favorable results, open bites with skeletal components are generally more difficult to treat with less stable results.[8,9] Environmental factors, including poor neuromuscular function of the lip or tongue, poor tongue posture and airway obstruction can also increase the risk of open bite.[8-11]

Thus, the reduction in the vertical dimensions obtained with the closing of the open bite and the consequent anterior mandibular projection facilitates a greater sealing between the tongue and the palate, through minimal muscle activity at rest, and leads to a significant oropharyngeal airway increase. Retroglossal volume increases considerably and the shape of the airways becomes less elliptical after closing the anterior open bite. [12]

Anterior open bite cases are very difficult to treat satisfactorily because of their multifactorial etiology and their very high relapse rate. Dependent on the origin of the anterior open bite malocclusion and the patient’s age, there are several treatment possibilities ranging from deterrent appliances, high-pull headgear, fixed appliances with and without extractions to orthognathic surgery, and skeletal anchorage with miniplates or miniscrews.[13]

The smile arc should be defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile. The ideal smile arc has the maxillary incisal edge curvature parallel to the curvature of the lower lip upon smile; the term consonant is used to describe this parallel relationship.[14]

Dental assessment consists of verifying the occlusion type, dental crowding, incisor inclination, presence of anterior open bite or deep bite, posterior cross-bite, and arch coordination.[15] Soft tissue evaluation includes both static and dynamic assessment. The following findings are noted: proportion of the face (rule of thirds), facial profile, nasolabial angle, mentolabial fold, interlabial gap, resting lip posture, mentalis strain, presence of gummy smile, anterior teeth show at rest and during smile, as well as an assessment of the smile arc.[14,15]

Smile esthetics after orthodontic treatment

In addition to the effects on the airways after open bite treatment, it is known that this malocclusion also causes changes in the individual's aesthetic appearance. To check if the smile's aesthetic increases with orthodontic treatment, Maclkey[16] conducted a study using pre- and post-treatment photographs in an oblique view of smiles. Five orthodontists and 6 parents evaluated 160 and 168 individuals, respectively, using a 5-point scale. There was a definite improvement, in the average of points, as a result of orthodontic treatment. The author, however, did not show any inferential statistics. In the evaluation of smile aesthetics, many variables are present and some are beyond orthodontic control.[17]

There is a close relationship between physical appearance and social attractiveness, and the face was considered the most important part of the body that regards attraction. The face is a stronger indicator of attractiveness in interpersonal communications.[18]

In a recent study by Sriphadungporn[19], it was stated that the most attractive smiles for laypeople were smiles with a 1–2-mm central to lateral incisor edge level difference. This is probably because laypeople are not as sensitive to such minor discrepancies as orthodontists, as also shown by Machado et al.[20] This study also found that laypeople were more tolerant of minor discrepancies by ranking altered smiles with higher scores.

The objective of orthognathic treatment is to correct the functional and aesthetic impairments of dentofacial deformities through combined orthodontic and surgical efforts.[21] Orthognathic therapy focuses on the treatment of dentofacial discrepancies which are beyond the scope of conventional orthodontic treatment, particularly severe Class II and Class III, anterior open bite or facial asymmetry.[22] The objective of orthognathic treatment is to correct the functional and aesthetic impairments of dentofacial deformities through combined orthodontic and surgical efforts. While patients may present to an orthognathic clinic for several reasons, improvement of facial appearance constitutes a prime concern.[21,23-26].

In 2017, Patcas investigated factors that motivate patients to seek orthognathic treatment, assessed how confident patients were that they would be satisfied with the outcome of treatment, and explored possible influencing factors.[24] The results concur with previous investigations which have identified functional and aesthetic factors to be the main reasons for patients undergoing orthognathic treatment.[24] Function, aesthetics and psycho-social aspects of life have been found to improve after treatment.[24] One finding that was evident in both centers of the said study was that females were more likely to be motivated by improvements in facial aesthetics than males. This observation is in agreement with previous investigations with European patients[27] but is in contrast with published data for an Asian population, in which improvement in facial aesthetics was considered equally important for both genders.[24,28]

The effects after orthodontic treatment of the open bite, whether in surgical or compensatory treatment, are well defined in the scientific literature.[12,29-31] However, there is still a deficiency in the literature regarding the evaluation of the attractiveness of the smile between the different treatment protocols of the anterior open bite.

Much research has been devoted to accurately evaluating the aesthetic outcome of orthognathic treatment.[21] Improvements in facial appearance have been studied based on self-reported scores of patients[21,32-34] or orthodontists and maxillofacial surgeons appraising the changes in soft tissue proportions and facial aesthetics[21].[35,36] However, all historical approaches fall short of adequately addressing the assessment of social attractiveness[21,36].

Patcas demonstrated that orthognathic treatment significantly improves facial attractiveness, both in males and females.[21] Concerning age appearance, people with severe malocclusions looked older than their real age, an observation more accentuated in males. Orthognathic therapy was able to reduce, but not to bridge, the gap between apparent and real age.[21]

The facial change following combined orthodontic and surgical treatment of class III malocclusion contributes to the judgment of the personality of an individual.[36] In a study by Jesani, findings support previous research that suggests poor dental and facial appearance exerts a negative influence on the appraisal of social perception.[36-41]

Few objective criteria exist for assessing attributes of the smile, establishing lip-teeth relationships as objectives of treatment, or measuring the soft tissue outcomes of treatment.[14] In orthodontic smile analysis, we usually evaluate the posed smile based on 2 major characteristics: the amount of incisor and gingival display and the transverse dimension of the smile.[14] Smile esthetics can be influenced by dental components and by oral soft tissues.[14,42]

Based on the above, this study aims to compare the attractiveness of the smile changes between the different protocols for treatment of the anterior open bite.

MATERIALS AND METHODS

This was a retrospective study approved by the ethical committee of Bauru Dental School, University of São Paulo, Brazil (protocol number 29996019.5.0000.5417).

The sample calculation was based on 5% alpha and a 20% beta to detect a difference of 1 point in the smile attractiveness, with a standard deviation of 0.96[43] resulting in the need for 15 patients in each group.

Sample characteristics

Therefore, a retrospective sample of 60 photographs of 30 individuals (15 treated surgically, 15 compensatory treated). Patients were selected from the files of orthodontists' practices in Bauru – SP. The patients were selected according to the following inclusion criteria: initial open bite malocclusion; treated with orthognathic surgery; orthodontically treated without extractions or with 2 or 4-premolar extractions; initial and final orthodontic records in good conditions. No profile or cephalometric characteristic was considered as inclusion criteria.

Patients were divided into 2 groups according to the treatment protocol: surgical (n=15) and compensatory (n=15).

The Surgical group (Group 1) comprised 15 subjects (9 male, 6 female) at an initial mean age of 20.53 years ± 4.72 years old, treated with fixed orthodontic appliance followed by orthognathic surgery, for a total mean period of 2.65 years ± 0.58. The mean open bite severity was 4.33mm ± 1.28mm. Three patients presented Class I malocclusion, three presented Class II malocclusion and nine patients presented Class III malocclusion.

The Compensatory group (Group 2) comprised 15 subjects (6 male, 9 female), at an initial mean age of 20.01 years ± 4.17 years, treated only with fixed orthodontic appliance, for a total mean period of 2.55 years ± 0.87 years. The mean open bite severity was 3.64mm ± 0.96mm. One patient presented Class I malocclusion, six presented Class II malocclusion and eight patients presented Class III malocclusion.

Treatment protocol

Treatments were performed with fixed edgewise appliances, with 0.022 x 0.028-inch conventional brackets. Wire sequences including initial 0.016-inch Nitinol, followed by 0.018, 0.020, and 0.018 x 0.025 or 0.019 x 0.025-inch stainless steel archwires (3M Unitek, Monrovia, Calif) were used during treatment. Accentuated and reversed curves of Spee were used to correct deep overbites. In the compensatory group, intermaxillary elastics were used to close the open bite. Patients treated with extractions for overjet and Class II canine correction the anterior teeth were retracted “en masse” with the use of rectangular archwires. In the surgical group, bimaxillary surgeries with maxillary impaction were performed. Depending on the type of malocclusion in the anterior segment, mandibular impaction or maxillary advancement was performed.

Smile evaluation

Smile photographs were taken of each patient at the pre- (T1) and posttreatment (T2) stages. The photographs were taken by the same investigator with the same camera (Nikon D80 with 100mm macro lens, Nikon, Japan), with the same distance from the camera to the face of the patient, and standardized natural head position and the patient looking forward.[42-44]

The images were cut in PhotoshopCS6 with an 18x13cm template to show only the mouth area. Facial blemishes and facial hair were removed from the smiling photographs. Then, the images were changed to black and white to mask any changes that could influence the assessment. All images had 300 dpi resolution and TIF format.

To evaluate the attractiveness of the smile, two types of evaluators will be chosen: laymen and dentists. In this study, the layman was defined as an individual without formal education in dentistry or dental hygiene. The dentist was considered to be a dental surgeon who has completed the graduate course in dentistry. Each layman and dentist received a message or email inviting them to participate in the research through a Google Forms link. All data were stored in a database accessible via the internet, only by the researcher.

The smile attractiveness was evaluated by a numerical rating scale from 0 to 10, with 0 being the least attractive and 10 being the most attractive smile. The evaluators were able to view the photographs for as long and as often as they

wish and change the responses if necessary. Support and answers to possible questions of the evaluators were provided.

The smiles were evaluated in a questionnaire by 116 participants, 53 dentists (mean age 31.70 years, SD=7.80) and 63 laypeople (mean age 36.08 years, SD=12.20).

Error study

To evaluate the precision of the evaluators in rating the smile attractiveness of the questionnaire, two smile photographs were randomly repeated throughout the questions, and the Intraclass correlation coefficient (ICC) was used.[45]

Statistical analysis

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

Intergroup comparability of the initial age, treatment time and initial severity of open bite were performed with independent t tests and sex distribution and type of malocclusion were performed with chi-square test.

Intragroup comparison of the initial and final stages was performed with dependent t tests. Intergroup comparison of the smile attractiveness was performed with independent t tests.

The comparability of the age and sex distribution of the two groups of evaluators was performed with independent t and chi-square tests, respectively. The score of the initial and final smile attractiveness between the two groups of evaluators was compared with independent t tests.

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 precision of the evaluators in rating the smile attractiveness varied from 0.84 to 0.94, indicating an excellent intra-rater agreement.[46]

There was comparability of the initial age, treatment time, initial severity of open bite, sex distribution and type of malocclusion (Table I).

In both groups, surgical and compensatory, there was a statistically significant improvement of the smile attractiveness with treatment (Table II).

At the initial and final stages, the smile of the compensatory group was significantly less attractive than the surgical group (Table III). However, the improvement of the smile attractiveness with treatment was similar in both groups (Table III).

The laypeople were significantly older than the dentists and there was comparability of the sex distribution between the groups (Table IV). The dentists were more critical in the evaluation of the initial smile attractiveness (Table V). In the final stage, the laypeople and the dentists judge similar smile attractiveness (Table V).

DISCUSSION

The influence of the open bite malocclusion treatment protocols on smile aesthetics was investigated in this study. It was assumed that the best treatment protocol was chosen for each patient at the time they were treated. It was not the aim of this study to investigate whether the treatment protocol applied to each patient was the best option. Therefore, intergroup comparisons of changes during treatment (T1-T2) were not evaluated. Many previous studies have described the effects of these treatments at the posttreatment stage.[47-49]

The groups were well matched regarding the initial age, treatment time, initial severity of open bite, sex distribution and type of malocclusion. This helps to eliminate confusing variables when discussing treatment results. The type of malocclusion did not influence the results since the two groups had great comparability regarding the type of malocclusion. It was very important that the open bite severity was compatible between and this was accomplished, making both groups and the compatibility between them more reliable.

Raters selection

The judgment of aesthetics is something completely personal and subjective, with sociocultural influences. Therefore, concepts of beauty and attractiveness can vary widely. Thus, besides 53 general dentists, 63 laypeople from different professional backgrounds were included. This was planned to mimic the judgment and motivation of lay patients when seeking orthodontic treatment to improve their esthetics.

Methodology

An untreated open bite control group was not used in this study because the primary objective was to evaluate whether there were differences in smile attractiveness between the surgical and compensator protocols and not with the untreated malocclusion. Besides, previous studies have already demonstrated the treatment changes of the open bite treatment.[48-50]

In the evaluation of smile aesthetics, many variables are present and some are beyond orthodontic control.[51] To eliminate confusing variables, it was preferred to exhibit only the smiles in the esthetic evaluation instead of including the whole face. This reduces the possibility of grading the smiles by characteristics that are not under orthodontic control, such as race, age, facial hair, color of the lips, part of the nose, cheeks, and chin.[52,53] It is important to focus on the esthetics of the smile without distracting the interviewees.[54] Conversion of color photographs to black and white is also important in the articles that judge smiles of different subjects because this procedure evens the skin shades of the sample and reduces the number of confounding factors.[54] The groups were also compatible regarding age, treatment time, open bite severity, sex distribution and type of malocclusion (Table I).

The analysis of the articles on the influence of orthodontic treatment suggests that a treatment modality alone cannot influence smile esthetics.[54] These results are expected because, in any group of subjects, there is individual variability—shape of the teeth, curl of the lips, and mouth expression—that could influence the smile perception as esthetically pleasing or not.[54] Therefore, it is not the fact of treating the open bite surgically or compensatory that influences overall smile harmony but rather the correct indication of treatment modalities.

Smile attractiveness

According to the raters, in both groups, surgical and compensatory, there was a statistically significant improvement of the smile attractiveness with treatment (Table II). This agrees with previous studies since it is known that orthodontic treatment promotes satisfactory improvement of the overbite, overjet, sagittal malocclusion, and facial appearance[48,55,56] as it was expected after both surgical and compensatory treatment.[55,56] The similarity in smile attractiveness among the groups may be consequent to the correct treatment protocol used in each patient.

Whether surgical or compensatory treatment, when correctly indicated, usually improves facial attractiveness.[43,57,58] The main issue is not about the best treatment, but the conditions under which each one is chosen.[43,59]

The improvement of the smile attractiveness with treatment was similar in both groups (Table III). However, at the initial and final stages, the smile of the compensatory group was significantly less attractive than the surgical group (Table III). This could be expected since some patients when faced with the need for surgical treatment, are not willing to treat surgically for personal or financial reasons and end up opting for compensatory treatment. This result is important because it shows how important it is to debate the best treatment options considering their correct indication, but also the conditions under each one is chosen. It is accepted that esthetic considerations are paramount in planning appropriate and orthognathic treatment but that rigid rules cannot be applied to all cases.[60]

The laypeople were significantly older than the dentists, and there was comparability of the sex distribution between the groups (Table IV). That has some implications because it is known that older people tend to be less critical in the evaluation of attractiveness.[19,61] Older laypeople were found to be less critical when evaluating different smiles images compared to a younger group.[19,61]

It was particularly relevant that the dentists were more critical in the evaluation of the initial smile attractiveness (Table V). This is because laypeople are not as sensitive to minor discrepancies as dentists.[20] On the other hand, in the final stage, the laypeople and the dentists judge similarly the smile attractiveness (Table V). As the orthodontics treatment finished and the smile approached an ideal esthetic, both dentists and laypeople judged similarly. Laypeople can identify various factors affecting smile esthetics.[60] Perception is

defined as a cognitive process involving interpretation of a stimulus and recognition of the object producing a sensation.[62] This process is based on earlier experience, and it represents the instrument by which one becomes acquainted with the environment.[60]

The number of raters in the questionnaire could be considered a limitation of this study because they are representing part of a population, and a misguided sample may have sufficient power to determine an effect for one particular parameter.[54] However, it should not interfere with the results since previous similar studies did not calculate the appropriate rater group size, and consequently, a minimum of 10 raters in each group was considered as an inclusion criterion, and we had a much larger number of evaluators in our study.[54]

Clinical implications

Dentists must be aware of the advantages and disadvantages of each treatment protocol. The analysis of the final attractiveness comparison between laypersons and dentists once again suggests that a treatment modality alone does not influence smile esthetics.[54] Therefore, it is not the fact that the open bite treated surgically or compensatory influences smile harmony but rather the correct indication of these types of treatment.

CONCLUSIONS

Based on the results of this specific study, it can be concluded that both surgical and compensatory treatments produce equally satisfactory results in terms of smile esthetics, however, at the end of the treatment, the surgical group showed greater attractiveness than the compensatory group, both for laypeople and dentists.

ACKNOWLEDGEMENT

We thank the Coordination for the Improvement of Higher Education Personnel (CAPES) for the financial support.

Figure legends:

Figure 1: The 10-point numerical scale under each profile photographs and the question about each individual's attractiveness.

3. Numa escala de 0 a 10, onde 0 é o menos atrativo e 10 é o mais atrativo, qual a sua avaliação para esse sorriso? *

0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

Figure 1: The 10-point numerical scale under each smile photographs and the question about each individual's attractiveness.

Table I. Results of intergroup comparability of initial and final ages, treatment time, initial severity of open bite, sex distribution and type of malocclusion.

Variables	GROUP 1 Surgical n=15	GROUP 2 Compensatory n=15	P
	Mean (SD)	Mean (SD)	
Initial age (years)	20.53 (4.72)	20.01 (4.17)	0.745 [T]
Treatment Time (years)	2.65 (0.58)	2.55 (0.87)	0.697 [T]
Open bite severity (mm)	4.33 (1.28)	3.64 (0.96)	0.106 [T]
Sex			X^2=1.20
Males	9	6	DF=1
Females	6	9	p=0.273 [α]
Type of malocclusion			X^2=2.06
Class I	3	1	DF=2
Class II	3	6	p=0.357 [α]
Class III	9	8	

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

Table II. Results of intragroup comparison of the initial and final smile attractiveness (dependent t test).

Smile attractiveness	Initial (T1)		Final (T2)		p
	Mean	SD	Mean	SD	
Group 1 - Surgical	3.46	2.56	6.03	2.32	**0.000***
Group 2 - Compensatory	2.84	2.27	5.39	2.40	**0.000***

* Statistically significant for p<0.05

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

Smile attractiveness	GROUP 1 Surgical n=15		GROUP 2 Compensatory n=15		p
	Mean	SD	Mean	SD	
Initial (T1)	3.46	2.56	2.84	2.27	**0.000***
Final (T2)	6.03	2.32	5.39	2.40	**0.000***
Treatment changes (T2-T1)	2.57	2.90	2.55	2.52	0.862

* Statistically significant for p<0.05

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

Variables	Laypeople N=63		Dentists N=53		P
	Mean	SD	Mean	SD	
Age (years)	36.08	12.20	31.70	7.80	**0.026*** [T]
Sex					X^2 =1.00
Female	31		31		DF=1
Male	32		22		p=0.318 [α]

* Statistically significant for p<0.05
[T] Independent t test
[α] chi-square test

Table V. Comparison of the groups of evaluators (independent t test).

Smile attractiveness	Laypeople N=63		Dentists N=53		P
	Mean	SD	Mean	SD	
Initial (T1)	3.49	2.64	3.10	2.45	**0.001***
Final (T2)	5.86	2.56	5.66	2.39	0.082

* Statistically significant for p<0.05

REFERENCES

1 - Beyer JW, Lindauer SJ. Evaluation of dental midline position Seminars in orthodontics: Elsevier; 1998: p. 146-152.
2 - Hulsey CM. An esthetic evaluation of lip-teeth relationships present in the smile. American journal of orthodontics 1970;57:132-144.
3 - Işıksal E, Hazar S, Akyalçın S. Smile esthetics: perception and comparison of treated and untreated smiles. American Journal of Orthodontics and Dentofacial Orthopedics 2006;129:8-16.
4 - Pilkington E. Esthetics and optical illusions in dentistry. The Journal of the American Dental Association (1922) 1936;23:641-651.
5 - Barrer HG. Limitations in orthodontics. Am J Orthod 1974;65:612-625.
6 - Moyers RE. Ortodontia. Guanabara Koogan; 1991.
7 - Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2016;149:269-276.
8 - Chung CJ, Hwang S, Choi YJ, Kim KH. Treatment of skeletal open-bite malocclusion with lymphangioma of the tongue. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2012;141:627-640.
9 - Cozza P, Mucedero M, Baccetti T, Franchi L. Early orthodontic treatment of skeletal open-bite malocclusion: a systematic review. The Angle orthodontist 2005;75:707-713.
10 - Cozza P, Baccetti T, Franchi L, Mucedero M, Polimeni A. Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2005;128:517-519.
11 - Ngan P, Fields HW. Open bite: a review of etiology and management. Pediatric dentistry 1997;19:91-98.
12 - Chen YJ, Chen HH, Hsu LF, Wang SH, Chen YJ, Lai EH et al. Airway increase after open bite closure with temporary anchorage devices for intrusion of the upper posteriors: Evidence from 2D cephalometric measurements and 3D magnetic resonance imaging. Journal of oral rehabilitation 2018;45:939-947.
13 - Reichert I, Figel P, Winchester L. Orthodontic treatment of anterior open bite: a review article--is surgery always necessary? Oral and maxillofacial surgery 2014;18:271-277.
14 - Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2001;120:98-111.
15 - Chu YM, Bergeron L, Chen YR. Bimaxillary protrusion: an overview of the surgical-orthodontic treatment. Seminars in plastic surgery 2009;23:32-39.
16 - Mackley RJ. An evaluation of smiles before and after orthodontic treatment. The Angle orthodontist 1993;63:183-189.

17 - Kim E, Gianelly AA. Extraction vs nonextraction: arch widths and smile esthetics. The Angle orthodontist 2003;73:354-358.
18 - Samsonyanová L, Broukal Z. A systematic review of individual motivational factors in orthodontic treatment: facial attractiveness as the main motivational factor in orthodontic treatment. International journal of dentistry 2014;2014:938274.
19 - Sriphadungporn C, Chamnannidiadha N. Perception of smile esthetics by laypeople of different ages. Progress in orthodontics 2017;18:8.
20 - Machado AW, McComb RW, Moon W, Gandini LG, Jr. Influence of the vertical position of maxillary central incisors on the perception of smile esthetics among orthodontists and laypersons. Journal of esthetic and restorative dentistry : official publication of the American Academy of Esthetic Dentistry ... [et al.] 2013;25:392-401.
21 - Patcas R, Bernini DAJ, Volokitin A, Agustsson E, Rothe R, Timofte R. Applying artificial intelligence to assess the impact of orthognathic treatment on facial attractiveness and estimated age. International journal of oral and maxillofacial surgery 2019;48:77-83.
22 - Cunningham SJ, Johal A. Orthognathic correction of dento-facial discrepancies. British dental journal 2015;218:167-175.
23 - Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics 1999;21:79-87.
24 - Patcas R, Cunningham SJ, Shute J, Lloyd T, Obwegeser JA, Arjomand L et al. Motivation for orthognathic treatment and anticipated satisfaction levels—a two-centre cross-national audit. Journal of Cranio-Maxillofacial Surgery 2017;45:1004-1009.
25 - Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics 1999;21:79-87.
26 - Ryan FS, Barnard M, Cunningham SJ. Impact of dentofacial deformity and motivation for treatment: A qualitative study. American Journal of Orthodontics and Dentofacial Orthopedics 2012;141:734-742.
27 - Athanasiou AE, Melsen B, Eriksen J. Concerns, motivation, and experience of orthognathic surgery patients: a retrospective study of 152 patients. Int J Adult Orthodon Orthognath Surg 1989;4:47-55.
28 - Yu D, Wang F, Wang X, Fang B, Shen SG. Presurgical motivations, self-esteem, and oral health of orthognathic surgery patients. J. Craniofac. Surg. 2013;24:743-747.
29 - Al Maaitah E, El Said N, Abu Alhaija ES. First premolar extraction effects on upper airway dimension in bimaxillary proclination patients. The Angle orthodontist 2012;82:853-859.
30 - Wang Q, Jia P, Anderson NK, Wang L, Lin J. Changes of pharyngeal airway size and hyoid bone position following orthodontic treatment of Class I bimaxillary protrusion. The Angle orthodontist 2012;82:115-121.
31 - Valiathan M, El H, Hans MG, Palomo MJ. Effects of extraction versus non-extraction treatment on oropharyngeal airway volume. The Angle orthodontist 2010;80:1068-1074.
32 - Hunt OT, Johnston CD, Hepper PG, Burden DJ. The psychosocial impact of orthognathic surgery: a systematic review. American journal of orthodontics and dentofacial orthopedics : official publication of the

American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2001;120:490-497.
33 - Schwitzer JA, Albino FP, Mathis RK, Scott AM, Gamble L, Baker SB. Assessing Patient-Reported Outcomes Following Orthognathic Surgery and Osseous Genioplasty. The Journal of craniofacial surgery 2015;26:2293-2298.
34 - Islam S, Aleem F, Ormiston IW. Subjective assessment of facial aesthetics after maxillofacial orthognathic surgery for obstructive sleep apnoea. The British journal of oral & maxillofacial surgery 2015;53:235-238.
35 - Storms AS, Vansant L, Shaheen E, Coucke W, de Llano-Pérula MC, Jacobs R et al. Three-dimensional aesthetic assessment of class II patients before and after orthognathic surgery and its association with quantitative surgical changes. International journal of oral and maxillofacial surgery 2017;46:1664-1671.
36 - Jesani A, DiBiase AT, Cobourne MT, Newton T. Perceived changes by peer group of social impact associated with combined orthodontic-surgical correction of class III malocclusion. Journal of dentistry 2014;42:1135-1142.
37 - Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. Am J Orthod 1985;87:21-26.
38 - Kerosuo H, Hausen H, Laine T, Shaw WC. The influence of incisal malocclusion on the social attractiveness of young adults in Finland. European journal of orthodontics 1995;17:505-512.
39 - Eli I, Bar-Tal Y, Kostovetzki I. At first glance: social meanings of dental appearance. Journal of public health dentistry 2001;61:150-154.
40 - Kershaw S, Newton JT, Williams DM. The influence of tooth colour on the perceptions of personal characteristics among female dental patients: comparisons of unmodified, decayed and 'whitened' teeth. British dental journal 2008;204:E9; discussion 256-257.
41 - Somani A, Newton JT, Dunne S, Gilbert DB. The impact of visible dental decay on social judgements: comparison of the effects of location and extent of lesion. International dental journal 2010;60:169-174.
42 - McNamara L, McNamara JA, Jr., Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2008;133:491-499.
43 - Janson G, Branco NC, Morais JF, Freitas MR. Smile attractiveness in patients with Class II division 1 subdivision malocclusions treated with different tooth extraction protocols. European journal of orthodontics 2011;36:1-8.
44 - Schabel BJ, McNamara Jr JA, Franchi L, Baccetti T. Q-sort assessment vs visual analog scale in the evaluation of smile esthetics. American Journal of Orthodontics and Dentofacial Orthopedics 2009;135:S61-S71.
45 - Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychological bulletin 1979;86:420.

46 - Enderlein G. Fleiss, JL: The Design and Analysis of Clinical Experiments. Wiley, New York–Chichester–Brislane–Toronto–Singapore 1986, 432 S.,£ 38.35: Wiley Online Library; 1988.
47 -Ng CS, Wong WK, Hagg U. Orthodontic treatment of anterior open bite. International journal of paediatric dentistry 2008;18:78-83.
48 - Solano-Hernández B, Antonarakis GS, Scolozzi P, Kiliaridis S. Combined orthodontic and orthognathic surgical treatment for the correction of skeletal anterior open-bite malocclusion: a systematic review on vertical stability. Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons 2013;71:98-109.
49 - Lentini-Oliveira D, Carvalho FR, Qingsong Y, Junjie L, Saconato H, Machado MA et al. Orthodontic and orthopaedic treatment for anterior open bite in children. The Cochrane database of systematic reviews 2007:Cd005515.
50 - Denny JM, Weiskircher MA, Dorminey JC. Anterior open bite and overjet treated with camouflage therapy. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2007;131:670-678.
51 - Mackley RJ. An evaluation of smiles before and after orthodontic treatment. The Angle orthodontist 1993;63:183-189; discussion 190.
52 -Johnson DK, Smith RJ. Smile esthetics after orthodontic treatment with and without extraction of four first premolars. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 1995;108:162-167.
53 - Janson G, Branco NC, Morais JF, Freitas MR. Smile attractiveness in patients with Class II division 1 subdivision malocclusions treated with different tooth extraction protocols. European journal of orthodontics 2014;36:1-8.
54 - Janson G, Branco NC, Fernandes TM, Sathler R, Garib D, Lauris JR. Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness. The Angle orthodontist 2011;81:153-161.
55. - Cruz-Escalante MA, Aliaga-Del Castillo A, Soldevilla L, Janson G, Yatabe M, Zuazola RV. Extreme skeletal open bite correction with vertical elastics. The Angle orthodontist 2017;87:911-923.
56 - Lopez-Gavito G, Wallen TR, Little RM, Joondeph DR. Anterior open-bite malocclusion: a longitudinal 10-year postretention evaluation of orthodontically treated patients. Am J Orthod 1985;87:175-186.
57 - Lim HJ, Ko KT, Hwang HS. Esthetic impact of premolar extraction and nonextraction treatments on Korean borderline patients. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2008;133:524-531.
58 - Boley JC, Pontier JP, Smith S, Fulbright M. Facial changes in extraction and nonextraction patients. The Angle orthodontist 1998;68:539-546.
59 - Bowman SJ, Johnston LE, Jr. The esthetic impact of extraction and nonextraction treatments on Caucasian patients. The Angle orthodontist 2000;70:3-10.

60 - Parrini S, Rossini G, Castroflorio T, Fortini A, Deregibus A, Debernardi C. Laypeople's perceptions of frontal smile esthetics: A systematic review. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics 2016;150:740-750.
61 - Santos RL, Pereira TB, Pithon MM. Esthetic perception of the buccal corridor in different facial types by laypersons of different ages. Biosci. j.(Online) 2015:1283-1290.
62 - Zajonc RB. On the primacy of affect 1984.

4 DISCUSSION

4 DISCUSSION

Previous studies have discussed the profile changes of surgical and compensatory treatments of the open bite malocclusion.(DENNY; WEISKIRCHER; DORMINEY, 2007; CHU; BERGERON; CHEN, 2009; CUNNINGHAM; JOHAL, 2015; CRUZ-ESCALANTE et al., 2017) However, a direct comparison of the treatment changes between these two different protocols has not been reported.

The main focus of this study was to compare the attractiveness effects between surgical and compensatory protocols among themselves and in relation to different evaluators. It was assumed that the best treatment protocol was chosen for each patient at the time they were treated. It was not the aim of this study to investigate whether the treatment protocol applied to each patient was the best option. Therefore, intergroup comparisons of changes during treatment (T1-T2) were not evaluated. Many previous studies have described the effects of these treatments at the posttreatment stage.(DENNY; WEISKIRCHER; DORMINEY, 2007; CUNNINGHAM; JOHAL, 2015) Since facial attractiveness is determined by a set of different facial attributes adequately arranged,(FLORES-MIR et al., 2004; BERTO et al., 2009; JANSON et al., 2015) no specific soft-tissue cephalometric variable was correlated in profile attractiveness in this study.

Methodology

Facial aesthetics concepts can vary widely because it is subjective and personal.(JANSON et al., 2015) To measure facial aesthetics, wide and different groups' opinions should be considered.(KOCADERELI, 2002; NAINI; MOSS; GILL, 2006; JANSON et al., 2015) Therefore, besides the 67 dentists, 46 laypeople from different professional areas were included.

The survey conducted through a website enabled a randomized order of evaluations for each rater.(JANSON et al., 2011) To avoid an exhausting process, they were able to observe the images as many times as they wanted, revise their assessments if necessary, independently, and without time constraints.(MCNAMARA et al., 2008; MENDES et al., 2019)

The 10-point numerical scale(JANSON et al., 2011) provided a simple, non-suggestive method of evaluation, reporting precisely and quantitatively the

raters' opinions.(JANSON et al., 2015) Reliability was ensured because no effort was made to guide the evaluation with attractive or unattractive examples.(JANSON et al., 2015; DOURADO et al., 2021)

The groups were comparable regarding pretreatment, treatment period, open bite severity, sex distribution and initial malocclusion (Table I). This helps to eliminate confusing variables when discussing treatment results. The type of malocclusion did not influence the results since the two groups had great comparability regarding the type of malocclusion. It was very important that the open bite severity was compatible between and this was accomplished, making both groups and the compatibility between them more reliable.

Facial attractiveness

Both groups showed statistically significant improvement of the profile attractiveness in the posttreatment period (Table II). This was expected since it is known that orthodontic treatment promotes improvement in the sagittal maxillomandibular relationship,(COZZA et al., 2005b; DENNY; WEISKIRCHER; DORMINEY, 2007) as it was expected after both surgical(LELLO, 1987; SOLANO-HERNÁNDEZ et al., 2013) and compensatory treatment.(COZZA et al., 2005b; DENNY; WEISKIRCHER; DORMINEY, 2007; CRUZ-ESCALANTE et al., 2017) The similarity in profile attractiveness among the groups may be consequent to the correct treatment protocol used in each patient.

Whether surgical or compensatory treatment, when correctly indicated, usually improves facial attractiveness.(BOLEY et al., 1998; LIM; KO; HWANG, 2008; JANSON et al., 2015) The main issue is not about the best treatment, but the conditions under which each one is chosen.(BOWMAN; JOHNSTON, 2000; JANSON et al., 2015)

Before treatment, the profile of the surgical group was significantly less attractive than the profile of the compensatory group (Table III). This is expected since surgical cases are usually more severe not only in the malocclusion severity but also in the profile attractiveness deficiency. The surgical group also presented a more attractive profile than the compensatory group at the final stage (Table III). Because orthognathic surgery works not only with dental corrections but also with the possibility of completely changing the soft tissue profile, unlike compensatory treatment and its limitations, this was predictable in the evaluation.

This could suggest that the surgical treatment of the open bite malocclusion had greater esthetic effects than the compensatory treatment.

The laypeople and dentists judged similarly the initial profile attractiveness (Table V). That has some implications because the present results show that even though laypeople may not be able to differentiate between the morphology of malocclusions, they are perfectly able to categorize them as unaesthetic. This ability to judge an unattractive profile is usually the main motivation for a lay patient to seek orthodontic treatment, even more so surgical treatment.(BAILEY et al., 2001)

For the final profile attractiveness, the laypeople were more critical than the dentists, assigning significantly lower scores to the subjects' attractiveness (Table V), likewise previous results.(BOWMAN; JOHNSTON, 2000; JANSON et al., 2015) These different views may be due to their different ages and sex. Laypeople group, slightly younger than the professional group, might have been less tolerant to what they considered lack of attractiveness. Professional raters, slightly older and quite used to accurate facial analysis, probably valued individual attributes that the lay ones did not. (TOLE et al., 2014; JANSON et al., 2015)

The results of this present study emphasize the importance of taking into account the viewpoint of the patient and ordinary people in the esthetic goals when planning and executing the orthodontic treatment. It was particularly relevant that laypeople appeared to be more judicious when rating a facial profile than general dentists.

Clinical implications

Strategies for open bite malocclusion treatment, whether in surgical or compensatory protocols, should consider important criteria such as facial appearance, malocclusion severity, patient age, available space for third molars, mechanical efficiency, and the challenges offered by each device or treatment protocol.

The similarity in profile attractiveness among the groups may be consequent to the correct treatment protocol used in each patient. Both surgical or compensatory treatment, when correctly indicated, usually improves facial attractiveness.(JULIE-HEIDE-MIYAZAKI WATANABE; DE FREITAS; CANÇADO, 2020) The main issue is not about the best treatment, but the

conditions which each one is chosen.(BOWMAN; JOHNSTON, 2000; JANSON et al., 2015) As laypersons were more critical for the assessment, it means that they are attentive to the beauty of the face, and we as professionals must be prepared to correctly explain the different treatment modalities and the esthetic effects arising from it, especially in borderline cases.

5 CONCLUSION

5 CONCLUSION

Based on the results of this specific study, it can be concluded that:

- At the final stage, the surgical group presented a more attractive and a greater improvement of the profile attractiveness than the compensatory group.
- The laypeople and dentists judged similarly the initial profile attractiveness.
- For the final profile attractiveness, the laypeople were more critical than the dentists.
- Both surgical and compensatory treatments produce equally satisfactory results in terms of smile esthetics, however, at the end of the treatment, the surgical group showed greater attractiveness than the compensatory group, both for laypeople and dentists.

REFERENCES

REFERENCES

1 - Al Maaitah E, El Said N, Abu Alhaija ES. First premolar extraction effects on upper airway dimension in bimaxillary proclination patients. The Angle orthodontist. 2012 Sep;82(5):853-9.

2 - Bailey L, Haltiwanger L, Blakey G, Proffit W. Who seeks surgical-orthodontic treatment: a current review. Int J Adult Orthodon Orthognath Surg. 2001 16(4):280-92.

3 - Barrer HG. Limitations in orthodontics. Am J Orthod. 1974 Jun;65(6):612-25.
Berto PM, Lima CS, Lenza MA, Faber J. Esthetic effect of orthodontic appliances on a smiling face with and without a missing maxillary first premolar. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2009 Apr;135(4 Suppl):S55-60.

4 - Boley JC, Pontier JP, Smith S, Fulbright M. Facial changes in extraction and nonextraction patients. The Angle orthodontist. 1998 Dec;68(6):539-46.
Bowman SJ, Johnston LE, Jr. The esthetic impact of extraction and nonextraction treatments on Caucasian patients. The Angle orthodontist. 2000 Feb;70(1):3-10.

5 - Chen YJ, Chen HH, Hsu LF, Wang SH, Chen YJ, Lai EH, et al. Airway increase after open bite closure with temporary anchorage devices for intrusion of the upper posteriors: Evidence from 2D cephalometric measurements and 3D magnetic resonance imaging. Journal of oral rehabilitation. 2018 Dec;45(12):939-47.
Chu YM, Bergeron L, Chen YR. Bimaxillary protrusion: an overview of the surgical-orthodontic treatment. Seminars in plastic surgery. 2009 Feb;23(1):32-9.

6 - Chung CJ, Hwang S, Choi YJ, Kim KH. Treatment of skeletal open-bite malocclusion with lymphangioma of the tongue. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2012 May;141(5):627-40.

7 - Cozza P, Baccetti T, Franchi L, Mucedero M, Polimeni A. Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2005a Oct;128(4):517-9.

8 - Cozza P, Mucedero M, Baccetti T, Franchi L. Early orthodontic treatment of skeletal open-bite malocclusion: a systematic review. The Angle orthodontist. 2005b 75(5):707-13.

9 - Cozza P, Mucedero M, Baccetti T, Franchi L. Early orthodontic treatment of skeletal open-bite malocclusion: a systematic review. The Angle orthodontist. 2005c Sep;75(5):707-13.

10 - Cruz-Escalante MA, Aliaga-Del Castillo A, Soldevilla L, Janson G, Yatabe M, Zuazola RV. Extreme skeletal open bite correction with vertical elastics. The Angle orthodontist. 2017 Nov;87(6):911-23.

11 - Cunningham SJ, Johal A. Orthognathic correction of dento-facial discrepancies. British dental journal. 2015 Feb 16;218(3):167-75.
Denny JM, Weiskircher MA, Dorminey JC. Anterior open bite and overjet treated with camouflage therapy. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2007 May;131(5):670-8.

12 - Dourado GB, Volpato GH, de Almeida-Pedrin RR, Oltramari PVP, Fernandes TMF, Conti ACdCF. Likert scale vs visual analog scale for assessing facial pleasantness. American Journal of Orthodontics and Dentofacial Orthopedics. 2021 160(6):844-52.

13 - Eli I, Bar-Tal Y, Kostovetzki I. At first glance: social meanings of dental appearance. Journal of public health dentistry. 2001 Summer;61(3):150-4.
Flores-Mir C, Silva E, Barriga MI, Lagravere MO, Major PW. Lay person's perception of smile aesthetics in dental and facial views. Journal of orthodontics. 2004 Sep;31(3):204-9; discussion 1.

14 - Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2016 Feb;149(2):269-76.

15 - Hunt OT, Johnston CD, Hepper PG, Burden DJ. The psychosocial impact of orthognathic surgery: a systematic review. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2001 Nov;120(5):490-7.

16 - Islam S, Aleem F, Ormiston IW. Subjective assessment of facial aesthetics after maxillofacial orthognathic surgery for obstructive sleep apnoea. The British journal of oral & maxillofacial surgery. 2015 Mar;53(3):235-8.

17 - Janson G, Branco NC, Morais JF, Freitas MR. Smile attractiveness in patients with Class II division 1 subdivision malocclusions treated with different tooth extraction protocols. European journal of orthodontics. 2011 36(1):1-8.

18 - Janson G, Junqueira CHZ, Mendes LM, Garib DG. Influence of premolar extractions on long-term adult facial aesthetics and apparent age. European journal of orthodontics. 2015 38(3):272-80.

19 - Jesani A, DiBiase AT, Cobourne MT, Newton T. Perceived changes by peer group of social impact associated with combined orthodontic-surgical correction of class III malocclusion. Journal of dentistry. 2014 Sep;42(9):1135-42.

20 - Julie-Heide-Miyazaki Watanabe FF, de Freitas D-S, Cançado R-H. Comparison of the facial profile attractiveness in Class III borderline patients after surgical or compensatory orthodontic treatment. Journal of Clinical and Experimental Dentistry. 2020 12(4):e348.

21 - Kerosuo H, Hausen H, Laine T, Shaw WC. The influence of incisal malocclusion on the social attractiveness of young adults in Finland. European journal of orthodontics. 1995 Dec;17(6):505-12.

22 - Kershaw S, Newton JT, Williams DM. The influence of tooth colour on the perceptions of personal characteristics among female dental patients: comparisons of unmodified, decayed and 'whitened' teeth. British dental journal. 2008 Mar 8;204(5):E9; discussion 256-7.

23 - Kocadereli I. Changes in soft tissue profile after orthodontic treatment with and without extractions. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2002 Jul;122(1):67-72.

24 - Lello GE. Skeletal open bite correction by combined Le Fort I osteotomy and bilateral sagittal split of the mandibular ramus. Journal of Cranio-Maxillofacial Surgery. 1987 15(132-6.

25 - Lim HJ, Ko KT, Hwang HS. Esthetic impact of premolar extraction and nonextraction treatments on Korean borderline patients. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2008 Apr;133(4):524-31.

26 - McNamara L, McNamara JA, Jr., Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2008 Apr;133(4):491-9.

27 - Mendes LM, Janson G, Zingaretti Junqueira-Mendes CH, Garib DG. Long-term profile attractiveness in Class II Division 1 malocclusion patients treated with and without extractions. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2019 Mar;155(3):362-71.

28 - Moyers RE. Ortodontia: Guanabara Koogan; 1991.

29 - Naini FB, Moss JP, Gill DS. The enigma of facial beauty: esthetics, proportions, deformity, and controversy. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics. 2006 Sep;130(3):277-82.

30 - Ngan P, Fields HW. Open bite: a review of etiology and management. Pediatric dentistry. 1997 Mar-Apr;19(2):91-8.

31 - Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics. 1999a 21(1):79-87.

32 - Nurminen L, Pietilä T, Vinkka-Puhakka H. Motivation for and satisfaction with orthodontic-surgical treatment: a retrospective study of 28 patients. European journal of orthodontics. 1999b Feb;21(1):79-87.

33 - Patcas R, Bernini DAJ, Volokitin A, Agustsson E, Rothe R, Timofte R. Applying artificial intelligence to assess the impact of orthognathic treatment on facial attractiveness and estimated age. International journal of oral and maxillofacial surgery. 2019 Jan;48(1):77-83.

34 - Patcas R, Cunningham SJ, Shute J, Lloyd T, Obwegeser JA, Arjomand L, et al. Motivation for orthognathic treatment and anticipated satisfaction levels—a two-centre cross-national audit. Journal of Cranio-Maxillofacial Surgery. 2017 2017/06/01/;45(6):1004-9.

35 - Reichert I, Figel P, Winchester L. Orthodontic treatment of anterior open bite: a review article--is surgery always necessary? Oral and maxillofacial surgery. 2014 Sep;18(3):271-7.

36 - Ryan FS, Barnard M, Cunningham SJ. Impact of dentofacial deformity and motivation for treatment: A qualitative study. American Journal of Orthodontics and Dentofacial Orthopedics. 2012 2012/06/01/;141(6):734-42.
Sarver DM, Weissman SM. Nonsurgical treatment of open bite in nongrowing patients. American Journal of Orthodontics and Dentofacial Orthopedics. 1995 108(6):651-9.

37 - Schwitzer JA, Albino FP, Mathis RK, Scott AM, Gamble L, Baker SB. Assessing Patient-Reported Outcomes Following Orthognathic Surgery and Osseous Genioplasty. The Journal of craniofacial surgery. 2015 Nov;26(8):2293-8.
Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. Am J Orthod. 1985 Jan;87(1):21-6.

38 - Solano-Hernández B, Antonarakis GS, Scolozzi P, Kiliaridis S. Combined orthodontic and orthognathic surgical treatment for the correction of skeletal anterior open-bite malocclusion: a systematic review on vertical stability.

Journal of oral and maxillofacial surgery : official journal of the American Association of Oral and Maxillofacial Surgeons. 2013 Jan;71(1):98-109.

39 - Somani A, Newton JT, Dunne S, Gilbert DB. The impact of visible dental decay on social judgements: comparison of the effects of location and extent of lesion. International dental journal. 2010 Jun;60(3):169-74.

40 - Storms AS, Vansant L, Shaheen E, Coucke W, de Llano-Pérula MC, Jacobs R, et al. Three-dimensional aesthetic assessment of class II patients before and after orthognathic surgery and its association with quantitative surgical changes. International journal of oral and maxillofacial surgery. 2017 Dec;46(12):1664-71.

41 - Tole N, Lajnert V, Kovacevic Pavicic D, Spalj S. Gender, age, and psychosocial context of the perception of facial esthetics. Journal of esthetic and restorative dentistry : official publication of the American Academy of Esthetic Dentistry [et al]. 2014 Mar-Apr;26(2):119-30.

42 - Valiathan M, El H, Hans MG, Palomo MJ. Effects of extraction versus non-extraction treatment on oropharyngeal airway volume. The Angle orthodontist. 2010 Nov;80(6):1068-74.

43 - Wang Q, Jia P, Anderson NK, Wang L, Lin J. Changes of pharyngeal airway size and hyoid bone position following orthodontic treatment of Class I bimaxillary protrusion. The Angle orthodontist. 2012 Jan;82(1):115-21.

APPENDIX

APPENDIX A - DECLARATION OF EXCLUSIVE USE OF THE ARTICLE IN DISSERTATION/THESIS

We hereby declare that we are aware of the article “Orthodontic treatment of anterior open bite: Comparison of profile and smile attractiveness in patients treated with surgical and compensatory protocols” will be included in Thesis of the student Cinthya Quagliato Nogueira and may not be used in other works of Graduate Programs at the Bauru School of Dentistry, University of São Paulo.

Bauru, February 29th, 2022.

Cinthya Quagliato Nogueira _____
Author Signature

Marcos Roberto de Freitas _____
Author Signature

_____ _____
Author Signature

_____ _____
Author Signature

ANNEXES

ANNEX A. Ethics Committee approval, protocol number 29996019.5.0000.5417 (front).

USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Tratamento da mordida aberta anterior: Comparação da atratividade do sorriso em pacientes tratados com protocolo cirúrgico e compensatório e avaliação dos efeitos em longo prazo de vias aéreas superiores

Pesquisador: Cinthya Quagliato Nogueira

Área Temática:

Versão: 1

CAAE: 29996019.5.0000.5417

Instituição Proponente: Universidade de São Paulo - Faculdade de Odontologia de Bauru

Patrocinador Principal: FUND COORD DE APERFEICOAMENTO DE PESSOAL DE NIVEL SUP

DADOS DO PARECER

Número do Parecer: 3.970.595

Apresentação do Projeto:

O Projeto tem por finalidade comparar a atratividade do sorriso através de fotografias em pacientes que foram submetidos ao tratamento ortodontico para correção de má oclusão assim como avaliação dos efeitos desse tratamento nas condições de vias aéreas superiores.

Objetivo da Pesquisa:

1. Avaliar a atratividade do sorriso entre os diferentes protocolos de tratamento da mordida aberta anterior e verificar a influência do tamanho do corredor bucal e exposição dos incisivos na estética do sorriso.
2. Avaliar e comparar através de telerradiografias, o comportamento a longo prazo das vias aéreas de pacientes com mordida aberta após tratamento ortodôntico.

A amostra, de caráter prospectivo e retrospectivo, será selecionada a partir de aproximadamente mais de 4000 casos tratados nos cursos de Pósgraduação (Lato e Stricto sensu) da Disciplina de Ortodontia da Faculdade de Odontologia de Bauru – Universidade de São Paulo.

Os critérios básicos para seleção da amostra incluíram as seguintes características:

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

ANNEX A. Ethics Committee approval, protocol number 29996019.5.0000.5417 (verso).

• Pacientes com mordida aberta anterior tratada ortodonticamente;
• Pacientes com mordida aberta anterior tratada cirurgicamente;
• Presença de todos os dentes permanentes até os primeiros molares;
• Ausência de anomalias quanto ao tamanho e/ou forma dos dentes;
• Ausência de diastemas na região anterior no pós-tratamento;
• Ausência de doença periodontal ativa;

A seleção da amostra será realizada em duas fases: a primeira através da avaliação dos modelos de gesso iniciais e finais e a segunda através de um exame intrabucal para verificar possível recidiva ou perda de algum elemento dentário.

Os pacientes que se adequarem aos critérios de inclusão, e se necessário, seus responsáveis, serão informados quanto ao delineamento do estudo e funcionamento da pesquisa. Caso não haja dúvidas, e houver mútuo acordo em participar do estudo, assinarão o Termo de Assentimento (Participante) e o Termo de Consentimento Livre e Esclarecido – TCLE (Responsável).Serão realizados exames clínicos intra orais em todos os participantes e caso seja detectado problemas como cárie, problemas periodontais e mesmo ortodônticos os participantes serão encaminhados na própria Universidade para o tratamento específico (segundo TCLE).

Avaliação dos Riscos e Benefícios:

Os participantes poderão sentir pequeno desconforto durante o exame clínico ou mesmo durante as tomadas fotográficas em virtude do uso de afastadores bucais.

Comentários e Considerações sobre a Pesquisa:

Sem comentários.

Considerações sobre os Termos de apresentação obrigatória:

Os documentos foram apresentados de forma devida.

Recomendações:

Sem recomendações importantes

Conclusões ou Pendências e Lista de Inadequações:

Diante do apresentado 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

ANNEX A. Ethics Committee approval, protocol number 29996019.5.0000.5417 (front).

USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

Continuação do Parecer: 3.970.595

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 Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1417650.pdf	05/03/2020 21:44:14		Aceito
Outros	CHECKLIST.pdf	05/03/2020 21:43:43	Cinthya Quagliato Nogueira	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	23/09/2019 12:03:37	Cinthya Quagliato Nogueira	Aceito
Projeto Detalhado / Brochura Investigador	CinthyaProjetoTeseFAPESP.pdf	23/09/2019 11:47:04	Cinthya Quagliato Nogueira	Aceito
Outros	CartaEncaminhamentoAssinado.pdf	23/09/2019 11:46:15	Cinthya Quagliato Nogueira	Aceito
Folha de Rosto	folhoderostoassinada.pdf	23/09/2019 11:37:22	Cinthya Quagliato Nogueira	Aceito
Declaração de Pesquisadores	DeclarCompromAssinada.pdf	03/09/2019 12:30:43	Cinthya Quagliato Nogueira	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BAURU, 14 de Abril de 2020

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

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
Bairro: VILA NOVA CIDADE UNIVERSITARIA **CEP:** 17.012-901
UF: SP **Município:** BAURU
Telefone: (14)3235-8356 **Fax:** (14)3235-8356 **E-mail:** cep@fob.usp.br

ANNEX B. Patient´s informed consent exoneration (front).

Universidade de São Paulo
Faculdade de Odontologia de Bauru

Departamento de Odontopediatria, Ortodontia e
Saúde Coletiva

Bauru, 01 de Janeiro de 2022.

Dispensa de Termo de Consentimento Livre Esclarecido e Termo de Assentimento

Como parte da documentação solicitada pelo Comitê de Ética em Pesquisa para a avaliação de projetos de pesquisas envolvendo seres humanos, encaminho justificativa para a dispensa de TCLE e Termo de Assentimento no Projeto de Pesquisa "**Tratamento da mordida aberta anterior: Comparação da atratividade do sorriso e perfil em pacientes tratados com protocolo cirúrgico e compensatório**" tendo como Responsável Principal Cinthya Quagliato Nogueira, sob orientação de por Marcos Roberto de Freitas.

A pesquisa prevê dispensa de TCLE e Termo de Assentimento, devido não ser uma pesquisa que requer participação direta dos indivíduos. Nela se utilizarão dados secundários do arquivo do departamento de Ortodontia, no caso, fotografias de pacientes previamente tratados, tomadas no inicio e no final do tratamento ortodontico, e já possuem TCLE assinados pelos pacientes autorizando a nos utilizarmos dessa documentação em pesquisas.

Atenciosamente,

Cinthya Quagliato Nogueira
Responsável Principal

Al. Dr. Octávio Pinheiro Brisolla, 9-75 – Bauru-SP – CEP 17012-901 – C.P. 73
e-mail: veragato@fob.usp.br – Fone/FAX (0xx14) 3235-8389
http://www.fob.usp.br