UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

GABRIELA JANSON

Conventional orthognathic surgery versus surgery first approach: occlusal outcomes, treatment time and efficiency

Resultados oclusais finais, tempo e eficiência do tratamento ortodôntico-cirúrgico convencional e com benefício antecipado

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Orientador: Profª. Drª. Daniela Gamba Garib Carreira

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“Cada sonho que você deixa para trás, é um pedaço do seu futuro que deixa de existir”.

Steve Jobs

RESUMO

Introdução: Diferentemente da Cirurgia Ortognática Convencional (COCTF), a Cirurgia de Benefício Antecipado (COBA) é realizada previamente a descompensação dentária, favorecendo a estética facial imediatamente. No entanto, especula-se que a recidiva esquelética da COBA tem influência nos resultados oclusais. **Objetivo:** Comparar os resultados oclusais finais, o tempo de tratamento e a eficiência proporcionados por ambas as abordagens ortodôntico-cirúrgicas. **Material e métodos:** O grupo COBA foi composto por 25 pacientes (7 homens, 18 mulheres) com idade média de 31,2 anos tratados com Benefício Antecipado. O grupo COCTF foi composto por 21 pacientes (10 homens, 11 mulheres) com idade média de 28,5 anos tratados com Cirurgia Ortognática Convencional. Ambos os grupos incluíram más oclusões de Classe I, II e III em proporções semelhantes. As variáveis cefalométricas foram avaliadas nos estágios de pré e pós-tratamento. Os índices OGS e PAR foram medidos em modelos de pré e pós-tratamento. A eficiência foi calculada como a taxa entre a redução percentual do PAR e o tempo de tratamento em meses. As comparações intergrupos foram realizadas utilizando-se testes t e Mann-Whitney ($p < 0,05$). **Resultados:** O grupo COBA apresentou maior aumento no comprimento mandibular em relação ao grupo COCTF. A discrepância maxilomandibular aumentou no grupo COBA e diminuiu no grupo COCTF. A altura da face inferior aumentou no grupo COBA e diminuiu no grupo COCTF. A inclinação do incisivo inferior e a espessura do lábio inferior diminuíram no grupo COBA e aumentaram no grupo COCTF. O grupo COBA apresentou melhores resultados oclusais (PAR final e OGS), menor tempo de tratamento e maior eficiência. **Conclusão:** A cirurgia de benefício antecipado apresentou melhores resultados oclusais com tempo de tratamento reduzido em comparação com a cirurgia ortognática convencional. A cirurgia de benefício antecipado foi mais eficiente do que a cirurgia ortognática convencional.

Palavras-chave: Cirurgia Ortognática. Tempo de Tratamento. Eficiência.

ABSTRACT

Conventional orthognathic surgery versus surgery first approach: occlusal outcomes, treatment time and efficiency

Introduction: Differently of the Conventional Orthognathic Surgery (COS), Surgery First Approach (SF) is performed prior to dental decompensation for immediate improvement of facial esthetics. However, the assumption that SF skeletal relapse influence the final occlusion has been raised. **Objectives:** To compare the occlusal outcomes, treatment time and efficiency of both orthodontic-surgical approaches. **Methods:** SF group comprised 25 patients (7 male, 18 female) with a mean age of 31.2 years treated with the surgery first approach. COS group comprised 21 patients (10 male, 11 female) with a mean age of 28.5 years treated with conventional orthognathic surgery. Both groups included similar ratio of Class I, II and III malocclusions. Cephalometric variables were measured at pre and posttreatment phases. OGS and PAR Index were evaluated in pre and posttreatment dental models. Efficiency was calculated as the rate between the percentage of PAR reduction and treatment time, in months. Intergroup comparisons were performed using t and Mann-Whitney tests ($p < 0.05$). **Results:** SF group showed a greater increase in the mandibular length compared to COS group. The maxillomandibular discrepancy increased in SF group and decreased in COS group. The lower face height increased in SF group and decreased in COS group. The mandibular incisor labial inclination and the lower lip thickness decreased in SF group and increased in COS group. SF group presented better occlusal outcomes (final PAR and OGS), shorter treatment time and greater efficiency. **Conclusion:** Surgery-first approach presented superior occlusal outcomes with a shorter treatment time compared to conventional orthognathic surgery. Surgery-first approach was more efficient than conventional orthognathic surgery.

Keywords: Orthognathic Surgery. Treatment Time. Efficiency.

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LIST OF ABBREVIATIONS AND ACRONYMS

SF	Surgery First
COS	Conventional Orthognathic Surgery
T1	Pre-treatment
T2	Posttreatment
IPAR	Initial PAR
FPAR	Final PAR
PAR-Red	PAR Reduction
TT	Treatment Time
TEI	Treatment Efficiency Index

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1 INTRODUCTION

1 INTRODUCTION

Orthognathic Surgery aims to correct severe skeletal dentofacial deformities in order to improve facial esthetics and oral function since it can affect directly on patient's quality of life and psychosocial well-being.(ALANKO; TUOMISTO; PELTOMAKI; TOLVANEN *et al.*, 2017; HUNT; JOHNSTON; HEPPER; BURDEN, 2001; KURABE; KOJIMA; KATO; SAITO *et al.*, 2016; MOTEGI; HATCH; RUGH; YAMAGUCHI, 2003; TAKATSUJI; KOBAYASHI; KOJIMA; HASEBE *et al.*, 2015) A few decades ago, the Conventional Orthognathic Surgery of Three Phases (COSTP) was established, it consists on a pre-surgical orthodontic phase, followed by skeletal surgical correction and postsurgical orthodontic phase. Due to the dental decompensation on pre-surgical phase, patients has the facial profile worsened,(LIAO; CHEN; CHEN; CHEN, 2020; URIBE; ADABI; JANAKIRAMAN; ALLAREDDY *et al.*, 2015; ZHOU; LI; WANG; ZOU *et al.*, 2016) which is disadvantage due to less satisfaction of the patient.(DOWLING; ESPELAND; KROGSTAD; STENVIK *et al.*, 1999)

Lately, the Surgery First Approach (SF) has been introduced.(BARONE; MORICE; PICARD; GIUDICE, 2021) This alternative dismiss the pre-surgical orthodontic phase,(HERNÁNDEZ-ALFARO; GUIJARRO-MARTÍNEZ; MOLINA-CORAL; BADÍA-ESCRICHE, 2011) the first step consists in the surgical correction of the jaws, followed by the decompensation and occlusal refinement in a single postsurgical orthodontic phase.(NARAN; STEINBACHER; TAYLOR, 2018) Due to this, facial esthetics improvement may be provided immediately after surgery in SF group, also, the reducement in total treatment time, which may lead to greater cooperation and satisfaction of the patient.(CHOI; LEE; YANG; KOH, 2015; HERNÁNDEZ-ALFARO; GUIJARRO-MARTÍNEZ; PEIRÓ-GUIJARRO, 2014; HUANG; HSU; CHEN, 2014)

Thus, good stability of maxillary surgical repositioning in both vertical and horizontal plane was reported,(HUANG; HSU; CHEN, 2014; YANG; XIAO; LIANG; WANG *et al.*, 2017) but, when quantifying the horizontal mandibular relapse, SF presented to be higher. This reducement on postsurgical stability must be related to unstable postsurgical occlusion, occlusal interference, functional memory of the

masticatory muscles and postsurgical tooth movement.(KIM; LEE; KYUNG; PARK *et al.*, 2014; PARK; SANDOR; KIM, 2016) Also, a clockwise rotation of mandible due to dental interferences, can be an expected effect, and not a skeletal relapse.(HUANG; CHEN, 2015)

Therefore, since it is speculated that the skeletal relapse of the SF interfere in the occlusal results and reduces treatment time,(HERNÁNDEZ-ALFARO; GUIJARRO-MARTÍNEZ; PEIRÓ-GUIJARRO, 2014; HUANG; CHEN, 2015; PEIRO-GUIJARRO; GUIJARRO-MARTINEZ; HERNANDEZ-ALFARO, 2016; URIBE; ADABI; JANAKIRAMAN; ALLAREDDY *et al.*, 2015; YANG; XIAO; LIANG; WANG *et al.*, 2017; YU; MAO; WANG; FANG *et al.*, 2015) not exposing patients to the pre-surgical esthetic deterioration,(FEU; DE OLIVEIRA; PALOMARES; CELESTE *et al.*, 2017; HUANG; CHEN; NI; ZHOU, 2016; PARK; CHOI; YANG; BAEK, 2015; PELO; GASPARINI; GARAGIOLA; CORDARO *et al.*, 2017; ZINGLER; HAKIM; FINKE; BRUNNER *et al.*, 2017) this study aimed to compare the occlusal results, treatment time and efficiency provided by both orthodontic-surgical protocols.

2 ARTICLE

2 ARTICLE

The article showed in this Dissertation was written according to American Journal of Orthodontic and Dentofacial Orthopedics instructions and guidelines for article submission.

CONVENTIONAL ORTHOGNATHIC SURGERY VERSUS SURGERY FIRST APPROACH: OCCLUSAL OUTCOMES, TREATMENT TIME AND EFFICIENCY

Abstract

Introduction: Differently of the Conventional Orthognathic Surgery (COS), Surgery First Approach (SF) is performed prior to dental decompensation for immediate improvement of facial esthetics. However, the assumption that SF skeletal relapse influence the final occlusion has been raised. **Objectives:** To compare the occlusal outcomes, treatment time and efficiency of both orthodontic-surgical approaches. **Methods:** SF group comprised 25 patients (7 male, 18 female) with a mean age of 31.2 years treated with the surgery first approach. COS group comprised 21 patients (10 male, 11 female) with a mean age of 28.5 years treated with conventional orthognathic surgery. Both groups included similar ratio of Class I, II and III malocclusions. Cephalometric variables were measured at pre and posttreatment phases. OGS and PAR Index were evaluated in pre and posttreatment dental models. Efficiency was calculated as the rate between the percentage of PAR reduction and treatment time, in months. Intergroup comparisons were performed using t and Mann-Whitney tests ($p < 0.05$). **Results:** SF group showed a greater increase in the mandibular length compared to COS group. The maxillomandibular discrepancy increased in SF group and decreased in COS group. The lower face height increased in SF group and decreased in COS group. The mandibular incisor labial inclination and the lower lip thickness decreased in SF group and increased in COS group. SF group presented better occlusal outcomes (final PAR and OGS), shorter treatment time and greater efficiency. **Conclusion:** Surgery-first approach presented superior occlusal outcomes with a shorter treatment time compared to conventional orthognathic surgery. Surgery-first approach was more efficient than conventional orthognathic surgery.

Keywords: Orthognathic Surgery. Outcomes. Treatment Time. Efficiency.

INTRODUCTION

Esthetics dissatisfaction is the major motivation of patients seeking orthodontic treatment.[1,2] Currently, adult patients demonstrate a high expectation for esthetic results and a desire for a short treatment time, regardless the initial severity of malocclusion.[1,3] Moderate to severe skeletal discrepancies cause facial esthetic impairment, requiring orthodontic-surgical treatment options.[4] In these cases, there are two therapeutic options: Conventional Orthognathic Surgery (COS) and Surgery First Approach (SF).[5,6] The gold-standard protocol (COS) is composed by three phases: (1) pre-surgical orthodontics, (2) conventional orthognathic surgery, and (3) post-surgical orthodontic finalization.[7] In COS, the pre-surgical orthodontic intervention is performed before surgery by decompensating the dentoalveolar component, worsening the malocclusion.[8-10] The disadvantage of COS is the esthetical impairment at the pre-surgical period, interfering in patients' quality of life, social relationship and self-perception.[11,12]

Performing surgical intervention before dental decompensation provides an immediate improvement in facial esthetics in SF.[13,14] Therefore, decompensation is performed after the chief complaint of the patient is already corrected. This improves the quality of life, self-esteem, as well as facilitates treatment acceptance.[15-18] In addition, the need of a unique orthodontic phase in SF might require a short treatment time compared to COS.[8,10,14] Some studies showed that SF can decrease total treatment time by accelerating orthodontic treatment after surgery.[19,20]

The primary stability of the orthognathic surgery is considered important for a successful outcome.[21] Primary stability consists in maintaining the condition obtained up to 12 months after surgery.[21,22] Although previous studies have concluded that the primary stability of skeletal changes provided by both protocols are similar,[10,14,23] a more recent systematic review pointed to a lower stability in the Surgery First intervention.[24] In addition, the mandibular position relapse with count-clockwise rotation was more frequently associated with the SF protocol than to the COS protocol. An increased skeletal instability would invariably affect the intra- and interarch occlusal relationship.[25] In addition, SF might demonstrate less predictability of the final occlusion since more mechanical adjustments would be necessary to achieve an ideal intercuspation, requiring excellent orthodontist skills.[26] These adjustments required for interarch intercuspation would inevitably affect the interincisive relationship and the final facial aspect.

However, the amount of information in the literature on the occlusal outcomes, treatment time and efficiency of SF is deficient. Comparisons between quality of the final occlusion between COS and SF have not been performed. In order to compare the cost-benefit of both approaches, the aim of this study was to compare the occlusal outcomes, treatment time and efficiency provided by both surgical protocols. The hypothesis was that Surgery First Approach has similar occlusal outcomes and efficiency compared to Conventional Orthognathic Surgery.

MATERIAL AND METHODS

Ethical approval was obtained from the Ethics in Research Committee of _____.

Sample size calculation showed that 12 patients were needed in each group, considering an 80% of test power at a significance level of 5%, to detect an intergroup difference of 1.5, with an estimated standard deviation of 1.26 in the Treatment Efficiency Index.

Forty-six patients were retrospectively selected from the files of the Private Collection of _____, according to the following criteria: 1) Complete initial and final orthodontic files; 2) Absence of craniofacial anomalies; 3) complete orthodontic charts; 4) Presence of conventional and digital dental models; and 5) Absence of supernumerary and/or abnormal tooth.

The sample was divided into two groups according to the orthodontic-surgical protocol. SF group consisted of 25 patients (7 male, 18 female) treated by the Surgery First Approach, with an initial mean age of 31.2 years (SD=8.14). All patients in this group were treated in two phases including the Orthognathic Surgery and the post-surgical orthodontic treatment. In this protocol, orthodontic appliances were installed right before surgery. Nine patients were treated using lingual appliances, three using clear aligners and 13 using conventional pre-adjusted fixed appliances. The post-surgical orthodontic treatment started 15 to 21 days after the orthognathic surgery. Skeletal Anchorage System (SAS) biomechanics was used during the orthodontic treatment in all patients. One to four miniplates were placed during the orthognathic surgery. All patients were treated by the same experienced orthodontist and maxillofacial surgeon.

COS group consisted of 21 patients (10 male, 11 female) with an initial mean age of 28.5 years (SD=9.40). All patients in this group were treated in three phases,

including pre-surgical orthodontic preparation, Orthognathic Surgery and post-surgical orthodontic treatment. In this protocol, all patients were treated by Labial Multibrackets Technique. The post-surgical orthodontic phase started 45 days after the orthognathic surgery. All patients were treated by one experienced orthodontist and maxillofacial surgeon, that was different from Group SF.

Patients of both groups were treated with mono or bimaxillary Surgery using Le Fort I osteotomies in the maxilla and bilateral sagittal osteotomy in the mandible with or without mentoplasty. The surgical movement performed was selected according to the initial severity of the skeletal discrepancy of each patient. Surgical rigid fixation including titanium miniplates and screws was used in both protocols. Surgical stabilization was maintained by intermaxillary elastics and miniplates for 15 to 21 days in SF group, and by full-time intermaxillary elastics in the first 45 days followed by night use until bone maturation (60 to 90 days) in the COS group.

Cephalometric analysis

Cephalometric radiographs of all patients were obtained at (T1) and (T2) and digitized using Microtek ScanMaker, model i800 (Microteck International, Inc., Carson, California, USA). Dolphin Imaging 11.5 software (Patterson Dental Supply, Inc., Chatsworth, California, USA) was used for correcting the image magnification factors and performing the cephalometric analysis. Angular and linear variables were used to analyze the skeletal, dentoalveolar and soft tissue T1-T2 changes (Table 1 and 3). The lateral cephalograms were blindly traced by one examiner (G.J.).

PAR Index

The Peer Assessment Rating (PAR) index was calculated in the pre-treatment (IPAR) and posttreatment (FPAR) digital dental models (.STL) using the Ortho Analyzer software (3shape, Copenhagen, Denmark).[28-30]

The degree of occlusal improvement PAR-Reduction was calculated as the difference between the pre-treatment and posttreatment scores (PAR-Reduction = InitialPAR - FinalPAR). The percentage of PAR Reduction (PcPAR) was calculated as IPAR-FPAR/IPAR x 100%, which reflects the PAR change in relation to the initial score. The Treatment Efficiency Index (TEI) was calculated as the rate between PcPAR and Treatment Time (TT) in months, expressed by TEI = PcPAR/TT.[27,31,32]

Posttreatment scores obtained for each PAR component were individually compared to determine the success rate achieved. To allow an individual evaluation, the PAR score at the end of treatment was separated into eight components: upper anterior segment, lower anterior segment, left buccal occlusion, right buccal occlusion, overjet, overbite and midline (Table 5).

OGS Index

The occlusal outcomes were evaluated using the Objective Grading System (OGS) from the American Board of Orthodontics (ABO). This system for scoring dental models and panoramic radiographs contains eight criteria: alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts and root angulation. The scores were blindly assigned by one examiner (G.J.).

Error study

After a 30-day interval, third percent of the sample were randomly selected and remeasured by the same examiner (G.J). The random errors were calculated using Dahlberg's formula ($Se2 = \sum d2/2n$), where Se^2 is the error variance and d is the difference between two determinations of the same variable.[33] The systematic errors were evaluated using dependent t tests, at $P<0.05$.

Statistical analyses

Normal distribution of the variables was verified with Shapiro-Wilk tests. Intergroup comparison of sex ratio and types of malocclusion was evaluated using Chi-square test. Intergroup comparisons were performed using t or Mann-Whitney tests.

The results were considered significant at $P<0.05$. The statistical analyses were performed with Statistica for Windows 10 software (Statsoft, Tulsa, Okla.).

RESULTS

The random errors ranged from 0.27 mm (FPAR) to 0.91 mm (IPAR). No statistically significant systematic errors were found. Among the 23 cephalometric variables, the random errors ranged from 1.72 (Lower Lip Thickness) to 4.61 mm (UFH) for the linear variables and from 1.47 (PP.FH) to 4.84 (Nasolabial Angle) for the

angular variables. Only one cephalometric variable presented significant systematic errors (maxillary length, Co-A).

The groups were comparable regarding the initial severity of anteroposterior skeletal discrepancy, IPAR, sex ratio and type of malocclusion (Table II). Eight cephalometric variables out of 22 measures were different at pre-treatment stage (Table III).

SF group demonstrated a greater increase in the mandibular length compared to COS group (Table III). The maxillomandibular discrepancy increased in SF group and decreased in COS group. COS group demonstrated a greater decrease in the upper face height compared to Group SF (diff=2.4mm). The lower face height increased in SF group and decreased in COS group. Mandibular incisor inclination (IMPA) and the lower lip thickness decreased in SF group and increased in COS group.

Patients treated with SF presented an improved final occlusal outcome (final PAR and OGS), a smaller treatment time and a greater efficiency than COS group (Table IV). Five out of 7 criteria of final PAR index showed better outcomes for SF group (Table V). For OGS, 4 out of 8 criteria revealed better occlusal outcomes for SF group compared to COS group (Table V).

DISCUSSION

In this study, patients treated with Surgery First and Conventional Orthognathic Surgery were compared regarding occlusal outcomes, treatment time and efficiency. Inclusion criteria were selected aiming a homogeneous sample. Both groups were comparable regarding the severity of the anteroposterior skeletal discrepancy (ANB angle), avoiding the influence of malocclusion complexity on the final results. Occlusal outcomes were measured using OGS and final PAR. The OGS is considered a gold-standard method to evaluate occlusal outcomes due the objective criteria used.[34,35] PAR index also permits to evaluate the occlusal changes over treatement.[28,36] In addition, PAR index allows a occlusal outcome evaluation with a high degree of precision and reproducibility.[28,37] Our results showed small random errors and no systematic errors for OGS and PAR index.

SF group presented a greater increase of the mandibular length compared to COS group (Table IV). These intergroup differences in the in mandibular length change are explained by the initial differences in the mandibular length with SF group demonstrating a shorter mandible compared to COS group (Table III). In addition, 21

out of 25 patients and 13 out of 21 patients had mentoplasty in groups SF and COS, respectively. As a consequence of a greater mandibular advancement in SF group, the maxillomandibular discrepancy showed a greater change in SF group.

COS group demonstrated a greater decrease in the upper face height compared to SF group. The reduction of the upper facial height is related to the surgical movement of the maxilla toward superior to correct the maxillary incisor display at rest.[38] Probably the maxillary incisor display was greater in the COS group, which required a greater maxillary impaction.

The lower face height slightly increased in SF group (1.1mm) and decreased by 3mm in COS group. These differences are explained by the lower height excess observed before treatment in COS group (Table III). The surgical decrease of lower facial height is explained by maxillary impaction followed by mandibular autorotation.[39,40] The superior movement of B Point can reduce face height after surgery.[14] According to Athanasiou[41], anterior face height does not change after setback surgery and in single-jaw surgical patients.[42]

In SF group, the mandibular incisors tip lingually while in COS group the mandibular incisors tip labially. These differences might be related to the amount of decompensation of mandibular incisors in the mandibular arch. The pre-treatment IMPA revealed that the mandibular incisors were more proclined in the SF group. We speculate that the severity of Class II malocclusion was greater in group SF and the severity of Class III malocclusion was greater in COS group. Severe skeletal Class II and Class III patients require a greater amount of decompensation during the pre-surgical orthodontic prepare in COS group and after surgery in SF group.[43-45] This is a limitation of this study. However, the occlusal outcomes, treatment time and efficiency were probably not influenced by these differences once the mean ANB angle of both groups were comparable.

The lower lip thickness decreased in SF group in accordance to the aforementioned mandibular incisor lingual inclination. Many studies revealed that lip thickness is directly affected by incisor labiolingual inclination.[46,47] The lower lip thickness is influenced by maxillary and mandibular incisors position, overjet and perioral muscles and underlying muscles attachments.[48] In Class III malocclusion, the decrease in the lower lip volume produce a facial esthetic improvement.[49]

The occlusal outcomes showed a greater improvement in SF group considering the final PAR and OGS reached a smaller score in this group. The PAR reduction from

pre-treatment to posttreatment stages was also greater in SF group. These results demonstrated that, when the orthodontic treatment is performed after the orthognathic surgery, adequate final occlusal outcomes are reached. The fact the surgery-first approach changes the order between orthodontic treatment and surgical intervention do not impair the final occlusal outcomes. Although the presence of a deeper curve of Spee, a greater negative overjet and greater mandibular setback would represent a common Surgery First instability,[23,50] the clinical reference for an occlusal ending is present in surgery-first approach considering the anteroposterior skeletal discrepancy was already corrected. Another reason for the adequate occlusal outcome in SF group was the use of miniplates. Skeletal anchorage produce more predictable postsurgical mechanics.[51] In addition, the use of Skeletal Anchorage System (SAS) increase the effectivity of certain dental movements.[23,52,53]

The total treatment time was 12.90 months (SD 6.22) in SF group and 35.18 months (SD 13.55) in COS group. The SF approach, reaching an improved occlusal outcome in a shorter time interval, demonstrated a greater efficiency. Nevertheless, these results are in agreement with previous reports, which revealed that Surgery First protocol can reduce the total treatment time with no major complications.[10,19] The reduction in total treatment time might be related to partial resolution of dentoalveolar compensation after surgery.[5,54] Also, orthodontic tooth movement may be facilitated by surgically induced Regional Acceleratory Phenomenon (RAP), a physiologic phenomenon involving accelerated bone turnover and decreased regional mineral density, during 3 to 4 months postsurgically.[5,55,56]

The Surgery First Approach can be considered an effective method to correct dentomaxillofacial deformities in surgical cases, providing adequate clinical results in a shorter period of time. SF also provides immediate facial improvement, greater patient cooperation and increased quality of life, achieving patients' satisfaction.[8,11,57] The limitation of this study was that, in consequence to the retrospective collection of sample, each group had a different orthodontist and surgeon, both highly qualified in their respective technique. However, groups were comparable regarding pre-treatment anteroposterior skeletal discrepancy (ANB angle), Initial PAR, sex ratio and type of malocclusions, which provided a homogenous sample. Future studies should evaluate the long-term treatment stability of both protocols.

CONCLUSIONS

Surgery First Approach resulted in a better final occlusal outcome and a shorter treatment time compared to Conventional Orthognathic Surgery. Therefore, surgery first approach showed a greater efficiency than the Conventional Orthognathic Surgery protocol.

Ethics approval

This retrospective study was approved by the Ethics in Research Committee of _____[number_____].

Conflict of Interest

None of the authors have any competing interests in the manuscript.

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Table I - Skeletal, dentoalveolar and soft tissue cephalometric variables.

Variable	Definition
Maxillary Skeletal Component	
Maxillary Lenght (CoA) (mm)	Condylion to A-point distance
SNA (º)	SN to NA angle
Mandibular Skeletal Component	
Mandibular Length (Co-Gn) (mm)	Condylion to Gnathion distance
SNB (º)	SN to NB angle
Maxillomandibular Relalionship	
Wits Appraisal (mm)	Distance between mandible and maxilla in relation to the occlusal plane
ANB (º)	NA to NB angle
Maxillomandibular Discrepancy (Co-Gn/Co-A) (mm)	Distance between mandible and maxilla in relation to the point Condylion
Vertical Component	
Palatal Plane Inclination (PP.FH) (º)	Palatal plane to Frankfurt plane angle
SN.GoGn (º)	SN to GoGn angle
Upper Face Height (N-ANS) (mm)	Distance between N and ANS points
Lower Face Height (ANS-Me) (mm)	Distance between ANB and Me points
Dental Relationship	
Overjet (mm)	Distance between incisal edge of maxillary and mandibular central incisor, parallel to occlusal pane
Overbite (mm)	Distance between incisal edge of maxillary and mandibular central incisor, perpendicular to occlusal plane
Interincisal Angle (Mx1.Md1) (º)	Angle between the longa xis of Mx1 and Md1
Mx1.NA (º)	Maxillary incisor longa axis to NA angle
IMPA (º)	Incisor mandibular plane angle
Soft Tissue Profile	
Nasolabial Angle (º)	Angle formed between the nose and upper lip
Upper Lip-E plane (mm)	Distance between upper lip to E plane
Lower Lip-E plane (mm)	Distance between lower lip to E plane
Upper Lip thickness (mm)	Distance between UL to Mx1
Lower Lip thickness (mm)	Distance between LL to Mx1
Chin thickness (mm)	Distance between Pog to Pog'

Table II - Intergroup comparison of pre-treatment anteroposterior skeletal discrepancy (ANB angle), Initial PAR, sex and type of malocclusions (T- and Chi-Square tests)

	SF Group (n=25)			**COS Group (n=21)**			
Variable	**Mean (SD)**			**Mean (SD)**			**P**
ANB (º)	3.16 (4.31)			2.93 (4.91)			0.856¥
Initial PAR	24.40 (13.00)			22.67 (12.03)			0.602€
Sex	F	M		F	M		0.169§
	18 72%	7 28%		11 52%	10 48%		
Malocclusion	Class I	Class II	Class III	Class I	Class II	Class III	0.956§
	4 16%	12 48%	9 36%	3 14%	11 53%	7 33%	

*Statistically significant at p<0.05
€ Mann-Whitney test
¥ T test
§Chi-Square tests

Table III - Intergroup comparison of cephalometric changes (t and Mann-Whitney)

Variable	SF Group (n=25)		COS Group (n=21)		P
	Mean	SD	Mean	SD	
Maxillary Skeletal Component					
Maxillary Lenght (CoA) (mm)	83.40	11.48	92.68	31.64	0.586€
SNA (º)	83.80	4.49	82.29	5.04	0.255¥
Mandibular Skeletal Component					
Mandibular Length (Co-Gn) (mm)	118.20	14.04	138.81	44.26	0.229€
SNB (º)	80.60	6.56	79.30	4.86	0.430¥
Maxillomandibular Relalionship					
Wits Appraisal (mm)	-0.90	6.06	-2.45	7.09	0.520€
ANB (º)	3.10	4.39	2.91	4.96	0.856¥
Maxillomandibular Discrepancy (Co-Gn/Co-A) (mm)	29.80	7.98	40.33	14.29	0.006*€
Vertical Component					
Palatal Plane Inclination (PP.FH) (º)	-1.30	3.62	-2.12	4.74	0.502¥
SN.GoGn (º)	31.30	8.32	37.48	7.96	0.016*€
Upper Face Height (N-ANS) (mm)	50.10	6.11	57.92	17.96	0.338€
Lower Face Height (ANS-Me) (mm)	66.70	6.99	84.04	24.69	0.003*€
Dental Relationship					
Overjet (mm)	2.50	2.93	4.76	5.44	0.096¥
Overbite (mm)	1.20	2.42	0.13	3.78	0.086€
Interincisal Angle (Mx1.Md1) (º)	122.40	10.85	124.30	11.71	0.583¥
Mx1.NA (º)	22.50	9.43	25.35	7.19	0.267¥
IMPA (º)	97.20	11.80	87.91	10.29	0.004*¥
Soft Tissue Profile					
Nasolabial Angle (º)	105.60	14.67	102.28	12.32	0.401¥
Upper Lip-E plane (mm)	-0.70	2.48	1.10	3.70	0.059¥
Lower Lip-E plane (mm)	-3.50	2.41	-3.30	3.90	0.776¥
Upper Lip thickness (mm)	12.50	2.51	16.37	5.73	0.025*€
Lower Lip thickness (mm)	13.40	2.71	16.25	5.32	0.020*¥
Chin thickness (mm)	12.80	1.64	15.15	5.29	0.143€

*Statistically significant at $p<0.05$
€ Mann-Whitney test
¥ T-test

Table IV - Intergroup comparison of cephalometric changes (t and Mann-Whitney tests)

Variable	SF Group (n=25)		COS Group (n=21)		P
	Mean	SD	Mean	SD	
Maxillary Skeletal Component					
Maxillary Lenght (CoA) (mm)	2.60	7.48	2.68	6.22	0682€
SNA (º)	2.60	3.33	2.19	2.45	0.535¥
Mandibular Skeletal Component					
Mandibular Length (Co-Gn) (mm)	6.40	10.79	1.43	9.38	0.037*€
SNB (º)	2.40	3.61	1.98	3.41	0.669¥
Maxillomandibular Relationship					
Wits Appraisal (mm)	-1.60	4.24	0.11	6.30	0.258¥
ANB (º)	0.20	3.57	0.13	3.93	0.935¥
Maxillomandibular Discrepancy (Co-Gn/Co-A) (mm)	2.40	5.23	-1.65	7.05	0.028*¥
Vertical Component					
Palatal Plane Inclination (PP.FH) (º)	-1.80	4.12	0.86	11.93	0.450€
SN.GoGn (º)	-1.10	5.25	-4.19	4.71	0.057¥
Upper Face Height (N-ANS) (mm)	-0.60	5.15	-3.00	4.44	0.047*€
Lower Face Height (ANS-Me) (mm)	1.10	5.27	-2.92	6.80	0.005*€
Dental Relationship					
Overjet (mm)	0.20	3.04	-1.52	4.62	0.235€
Overbite (mm)	0.10	2.23	1.50	3.89	0.113¥
Interincisal Angle (Mx1.Md1) (º)	3.90	9.96	1.87	8.19	0.431¥
Mx1.NA (º)	-3.70	7.98	-3.33	7.85	0.863¥
IMPA (º)	-2.10	8.34	3.34	7.64	0.022*€
Soft Tissue Profile					
Nasolabial Angle (º)	-1.90	8.61	-1.71	11.69	0.955¥
Upper Lip-E plane (mm)	-0.20	2.25	-0.36	2.18	0.976¥
Lower Lip-E plane (mm)	-1.60	2.26	-2.87	2.99	0.122¥
Upper Lip thickness (mm)	0.20	2.36	-0.92	2.19	0.233€
Lower Lip thickness (mm)	-2.10	3.05	0.29	4.37	0.043*€
Chin thickness (mm)	-0.70	2.42	0.30	3.78	0.264¥

*Statistically significant at $p<0.05$
€ Mann-Whitney test
¥ T-test

Table V - Intergroup comparison of occlusal outcomes, treatment time and efficiency (T-tests)

Variable	**SF Group (n=25)**		**COS Group (n=21)**		**P**
	Mean	**SD**	**Mean**	**SD**	
Final PAR	0.80	1.98	7.35	3.95	0.001*€
OGS	12.40	3.50	21.96	6.92	0.000*¥
PAR-Reduction	23.50	12.63	15.21	11.97	0.022*¥
PcPAR	96.50	6.88	61.65	25.68	0.000*€
Treatment time	12.90	6.22	35.18	13.55	0.001*€
TEI	9.05	4.07	2.29	2.26	0.000*€

*Statistically significant at $p<0.05$
€ Mann-Whitney test
¥ T-test

Table VI - Intergroup comparison of each criteria of Final PAR and OGS indexes (T-test and Mann-Whitney)

Variable	**SF Group (n=25)**		**COS Group (n=21)**		**P**
	Mean	**SD**	**Mean**	**SD**	
Final PAR					
Upper Anterior Segment	0.10	0.47	0.65	0.63	0.015*€
Lower Anterior Segment	0.00	0.20	0.21	0.52	0.259*€
Left Buccal Occlusion	0.00	0.20	1.02	0.73	0.003*€
Right Buccal Occlusion	0.00	0.00	0.98	0.52	0.003*€
Overjet	0.70	1.95	4.21	3.31	0.000*€
Overbite	0.00	0.00	0.00	0.00	0.992€
Centerline	0.00	0.00	0.18	0.82	0.793€
OGS					
Alignment	2.40	1.24	3.98	1.32	0.806¥
Marginal Ridges	2.60	1.49	2.82	2.08	0.942€
Buccolingual Inclination	3.80	2.58	6.00	3.46	0.033*€
Overjet	1.80	1.71	2.79	2.60	0.259€
Occlusal Contacts	0.10	0.42	0.70	1.15	0.047*€
Occlusal Relationships	0.00	0.00	2.70	3.37	0.008*€
Interproximal Contacts	0.00	0.40	0.02	0.28	0.986€
Root Angulation	1.40	0.73	2.84	1.31	0.005*€

*Statistically significant at $p<0.05$
€ Mann-Whitney test
¥ T-test

3 DISCUSSION

3 DISCUSSION

The present study aimed to compare two different orthodontic-surgical protocols, the Surgery First Approach (SF) and the Conventional Orthognathic Surgery (COS). All individuals had cephalometric radiographs and dental models evaluated at pre-treatment (T1) and posttreatment (T2). Previous studies reported that SF can shorten total treatment time, and that COS produces better treatment outcomes.(PEIRO-GUIJARRO; GUIJARRO-MARTINEZ; HERNANDEZ-ALFARO, 2016; URIBE; ADABI; JANAKIRAMAN; ALLAREDDY *et al.*, 2015; YANG; XIAO; LIANG; WANG *et al.*, 2017) Thus, the occlusal outcomes, treatment time and efficiency of both protocols were evaluated.

Important changes were observed when comparing skeletal, dentoalveolar and soft tissue changes. Greater differences were observed in mandibular length, maxillomandibular discrepancy, upper face height, lower face height, mandibular incisor inclination (IMPA) and in the lower lip thickness. Also, occlusal outcomes evaluation with PAR and OGS index presented significantly better results for SF group than COS group regarding the following criteria: upper anterior segment, lower anterior segment, left buccal occlusion, right buccal occlusion and overjet for PAR and alignment, buccolingual inclination, occlusal relationships, occlusal contacts and root angulation for OGS index. All results contributed to a better occlusal result in the SF group. Also, SF group showed a reduced treatment time when compared to COS group.(HUANG; HSU; CHEN, 2014; PEIRO-GUIJARRO; GUIJARRO-MARTINEZ; HERNANDEZ-ALFARO, 2016; YANG; XIAO; LIANG; WANG *et al.*, 2017) The absence of a pre-surgical orthodontic phase, in addition to the use of Skeletal Anchorage System (SAS)(NAGASAKA; SUGAWARA; KAWAMURA; NANDA, 2009; SHARMA; YADAV; TANDON, 2015; SUGAWARA; NAGASAKA; YAMADA; YOKOTA *et al.*, 2018) and increased osteoblastic activities and metabolic changes caused by Orthognathic Surgery,(FROST, 1983; LIOU; CHEN; WANG; YU *et al.*, 2011) possibilitate postsurgical accelerated orthodontic tooth movement and improvement of the occlusal outcomes.

The results obtained concluded that Surgery First Approach provides good occlusal outcomes in a shorter treatment time compared to Conventional Orthognathic Surgery. Then, greater efficiency is observed in this group. This study can help orthodontists and surgeons to act with more predictability and scientific based. Considering a few limitations of the study, to improve following others, we suggest an evaluation of long-term treatment stability.

4 CONCLUSION

4 CONCLUSION

Surgery First Approach resulted in a better final occlusal outcome and a shorter treatment time compared to Conventional Orthognathic Surgery. Therefore, surgery first approach showed a greater efficiency than the Conventional Orthognathic Surgery protocol.

REFERENCES

REFERENCES

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ANNEXES

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SOLICITAÇÃO DE DISPENSA DE TCLE

Solicitamos ao Comitê de Ética em Pesquisa FOB-USP, a dispensa do Termo de Consentimento Livre e Esclarecido do projeto de pesquisa intitulado "Resultados oclusais finais, tempo e eficiência do tratamento ortodôntico-cirúrgico convencional e com benefício antecipado", para utilização de dados de pacientes já tratados como fonte para este estudo.

Os dados ortodônticos são provenientes de acervo particular da clínica Graziani Odontologia Personalizada, CROCL-PA 298, responsável técnico Graziane Olímpio Pereira, CROPA 3739, localizada em Belém – Pará, criado especificamente para propiciar, hoje, a realização de pesquisas como esta.

Frente aos anos decorridos desde a realização dos tratamentos (datando o último de 2016), não é possível localizar os pacientes para assinatura do termo. Ademais, o estudo não divulgará nenhuma imagem ou dado que permita identificação dos pacientes, bem como não serão realizadas novas intervenções de nenhuma natureza em decorrência da realização do mesmo.

Assim, solicitamos a dispensa do TCLE individual dos pacientes.

Bauru, 12 de Junho de 2020

Guilherme Janson	Marcelo Vinicius Valerio
Orientador	Pesquisador Responsável

USP - FACULDADE DE ODONTOLOGIA DE BAURU DA USP

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: Resultados oclusais finais, tempo e eficiência do tratamento ortodôntico-cirúrgico convencional e com benefício antecipado.

Pesquisador: Marcelo Valerio

Área Temática:

Versão: 5

CAAE: 32015020.1.0000.5417

Instituição Proponente: Universidade de Sao Paulo

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.224.404

Apresentação do Projeto:

O pesquisador apresenta uma emenda solicitando alterações no projeto: aumento do número de participantes de 40 para 46, alteração de variáveis avaliadas (inclusão de novas análises cefalométricas) e de novo método de avaliação dos dados (inclusão da análise do modelo ortodôntico digital).

Objetivo da Pesquisa:

Os objetivos deste estudo serão comparar os resultados oclusais finais, o tempo e a eficiência de tratamento das abordagens ortodôntico-cirúrgicas de C.O.C.T.F. (convencional) e C.O.B.A (benefício antecipado).

Avaliação dos Riscos e Benefícios:

As solicitações de mudanças não implicam em alterações nos riscos e benefícios constantes na PB conforme descritos abaixo:

Riscos:

Os pacientes não serão atendidos, de forma que não haverá risco físico de nenhuma natureza. Uma vez que os dados dos pacientes serão utilizados, existe o risco de vazamento dos dados por apropriação indevida não-consentida, por terceiros, durante os trâmites da realização do trabalho. Para minimizar este risco, os dados dos pacientes ficarão contidos apenas em HD externo, e,

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sempre que forem acessados, o computador utilizado estará desconectado da internet e estará fora de rede intranet.

Benefícios:
Como as comparações propostas neste trabalho nunca foram realizadas, as comunidades ortodôntica e cirúrgica, atualmente, carecem de embasamento científico para a tomada de decisão em casos limítrofes, passíveis de tratamento pelos dois protocolos (COCTF e COBA). Ter conhecimento das diferenças e semelhanças entre o desempenho de ambos permitirá que esta decisão seja segura. Independentemente da existência de diferença significante ou da semelhança entre os protocolos, para cada comparação, a existência da evidência servirá como base tratamentos ortodôntico-cirúrgicos que venham a ser realizados futuramente. Atualmente, o que existe é uma especulação de pior resultado oclusal final no protocolo COBA e menor eficiência de tratamento do protocolo COCTF. Estas especulações influenciam na escolha diária dos ortodontistas e cirurgiões bucomaxilofaciais. Uma vez investigadas, serão aceitas ou rejeitadas, mas, de qualquer forma, será possível aos pacientes que estes sejam tratados segundo o que é concreto, e não especulado. Da mesma forma, será possível ao ortodontista e ao cirurgião bucomaxilofacial atuarem embasados cientificamente e não sujeitos a especulações não investigadas.

Comentários e Considerações sobre a Pesquisa:
Foi apresentado um termo de aquiescência da clinica a partir da qual a documentação será obtida. Importante destacar que houve uma alteração do nome do responsável pela clínica.
A PB foi alterada adequadamente, constando agora todas as modificações solicitadas.

Considerações sobre os Termos de apresentação obrigatória:
A folha de rosto foi apresentada de forma satisfatória.

Recomendações:
nenhuma

Conclusões ou Pendências e Lista de Inadequações:
sem pendências.

Considerações Finais a critério do CEP:
A emenda apresentada pelo(a) pesquisador(a) foi considerada APROVADA ad referendum deste CEP, em 04/02/2022, com base nas normas éticas da Resolução CNS 466/12. Ao término da

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Continuação do Parecer: 5.224.404

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_INFORMAÇOES_BASICAS_1888072_E2.pdf	03/02/2022 17:54:38		Aceito
Outros	Oficio_Emenda3.pdf	03/02/2022 17:53:28	Marcelo Valerio	Aceito
Outros	Termo_de_Aquiescencia_do_Profissional_Responsavel_2.pdf	03/02/2022 17:35:53	Marcelo Valerio	Aceito
Folha de Rosto	Folha_de_Rosto.pdf	03/02/2022 17:34:25	Marcelo Valerio	Aceito
Outros	Oficio_Emenda2.pdf	21/01/2022 20:45:34	Marcelo Valerio	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_Marcelo_Vinicius_Valerio_Revisado2.pdf	21/01/2022 20:45:05	Marcelo Valerio	Aceito
Outros	Oficio_Emenda.pdf	05/10/2021 23:06:49	Marcelo Valerio	Aceito
Outros	OFICIO.pdf	18/06/2020 15:14:17	Marcelo Valerio	Aceito
Outros	Termo_de_Aquiescencia_Revisado.pdf	18/06/2020 15:08:50	Marcelo Valerio	Aceito
Declaração de Pesquisadores	DeclaracaoCompromissoPesquisadorResultadosPesquisa_Revisado.pdf	18/06/2020 15:07:53	Marcelo Valerio	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	Solicitacao_Dispensa_TCLE.pdf	18/06/2020 15:06:16	Marcelo Valerio	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_Marcelo_Vinicius_Valerio_Revisado.pdf	18/06/2020 15:04:03	Marcelo Valerio	Aceito
Cronograma	Cronograma_revisado.pdf	18/06/2020 15:03:48	Marcelo Valerio	Aceito
Outros	Check_listCEP_2019.pdf	12/05/2020 16:09:03	Marcelo Valerio	Aceito

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Continuação do Parecer: 5.224.404

Outros	Termo_de_Aquiescencia_do_Profissional_Responsavel.pdf	12/05/2020 14:05:58	Marcelo Valerio	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	Autorizacao_para_uso_de_dados_e_imagem.pdf	12/05/2020 14:04:36	Marcelo Valerio	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_Marcelo_Vinicius_Valerio.pdf	12/05/2020 14:01:32	Marcelo Valerio	Aceito
Outros	Termo_de_Aquiescencia.pdf	28/04/2020 11:55:43	Marcelo Valerio	Aceito
Cronograma	Cronograma.docx	23/04/2020 16:28:04	Marcelo Valerio	Aceito
Declaração de Pesquisadores	DeclaracaoCompromissoPesquisadorResultadosPesquisa.doc	23/04/2020 16:21:36	Marcelo Valerio	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BAURU, 04 de Fevereiro de 2022

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

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Graziani
odontologia personalizada

AUTORIZAÇÃO PARA USO DE DADOS E IMAGEM

Por este instrumento de autorização por mim assinado, eu, Pedro Graziani Olímpio Pereira, CROPA 3.739, dou pleno consentimento, gratuita e espontaneamente, ao meu colega Marcelo Vinicius Valerio e aos membros da sua equipe de pesquisa, aluno regular do curso de Doutorado em Ciências Odontológicas Aplicadas da Faculdade de Odontologia de Bauru, Universidade de São Paulo, na área de concentração Ortodontia e Odontologia em Saúde Coletiva, disciplina de Ortodontia, para que inclua dados advindos mais 6 documentações ortodônticas, além daquelas já cedidas anteriormente, constantes no acervo da minha clínica, para fins de pesquisa científica, como parte do projeto intitulado "Resultados oclusais finais, tempo e eficiência do tratamento ortodôntico-cirúrgico convencional e com benefício antecipado", incluindo imagens radiográficas e modelos, bem como quaisquer dados relativos ao ínterim dos tratamentos. Declaro também autorizar e estar ciente de que o pesquisador usará também os modelos digitais dos pacientes, cujos arquivos cederei a ele. O direito de uso de todos estes dados foi assegurado por cada paciente a mim, bem como me foi assegurado o direito de estender sua utilização a quem eu venha a julgar competente, para fins de pesquisa científica, conforme o documento já previamente submetido nesta plataforma no início do curso deste projeto "Autorização para uso de dados e imagem".

A utilização deste material não gera nenhum compromisso de ressarcimento, a qualquer preceito, por parte do cirurgião-dentista ou de seus colaboradores, pesquisadores ou pacientes.

Belém, 03 de fevereiro de 2022.

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