UNIVERSIDADE FEDERAL DO CEARÁ
FACULDADE DE FARMÁCIA, ODONTOLOGIA E ENFERMAGEM
DEPARTAMENTO DE ODONTOLOGIA
PROGRAMA DE PÓS-GRADUAÇÃO EM ODONTOLOGIA

ALINE LEVI BARATTA MONTEIRO

ANÁLISE DO PADRÃO FACIAL DE PACIENTES CLASSE II EM CRESCIMENTO APÓS O TRATAMENTO COM APARELHO DE THUROW MODIFICADO

FORTALEZA
2022

ALINE LEVI BARATTA MONTEIRO

ANÁLISE DO PADRÃO FACIAL DE PACIENTES CLASSE II EM CRESCIMENTO APÓS O TRATAMENTO COM APARELHO DE THUROW MODIFICADO

Tese apresentada ao Programa de Pós-Graduação em Odontologia da Universidade Federal do Ceará, como requisito parcial à obtenção do título de Doutora em Odontologia. Área de concentração: Clínica Odontológica.

Orientador: Prof. Dr. José Jeová Siebra Moreira Neto.

FORTALEZA

2022

Dados Internacionais de Catalogação na Publicação
Universidade Federal do Ceará
Biblioteca Universitária
Gerada automaticamente pelo módulo Catalog, mediante os dados fornecidos pelo(a) autor(a)

M774a Monteiro, Aline Levi Baratta
Análise do padrão facial de pacientes Classe II em crescimento após o tratamento com aparelho de Thurow modificado / Aline Levi Baratta Monteiro. – Fortaleza, 2021.
81 f.: il. color
Tese (doutorado) – Universidade Federal do Ceará, Faculdade de Farmácia, Odontologia e Enfermagem, Programa de Pós-graduação em Odontologia, Doutorado em Odontologia, Fortaleza, 2022
Área de concentração: Clínica Odontológica.
Orientação: Prof. Dr. José Jeová Siebra Moreira Neto.

1. Má oclusão Classe II de Angle Divisão 1. 2. Aparelhos de tração extrabucal. 3. Cefalometria. 4. Dimensão vertical. I. Título.

CDD 617.6

ALINE LEVI BARATTA MONTEIRO

ANÁLISE DO PADRÃO FACIAL DE PACIENTES CLASSE II EM CRESCIMENTO APÓS O TRATAMENTO COM APARELHO DE THUROW MODIFICADO

Tese apresentada ao Programa de Pós-Graduação em Odontologia da Universidade Federal do Ceará, como requisito parcial à obtenção do título de Doutora em Odontologia Área de concentração: Clínica Odontológica.

Aprovada em: ___/___/_____.

BANCA EXAMINADORA

_____

Prof. Dr. José Jeová Siebra Moreira Neto (Orientador)

Universidade Federal do Ceará (UFC)

_____

Prof. Dr. Cauby Maia Chaves Júnior

Universidade Federal do Ceará (UFC)

_____

Prof. Dr. Renato Luiz Maia Nogueira

Universidade Federal do Ceará (UFC)

_____

Prof. Dr. Benedito Viana Freitas

Universidade Federal do Maranhão (UFMA)

_____

Prof. Dr. Vilmar Antônio Ferrazzo

Universidade Federal de Santa Maria (UFSM)

A Deus.

Aos meus pais, Washington e Esty.

Ao meu esposo, Pedro César, e aos meus filhos,

Marina, Mirela e João Pedro.

AGRADECIMENTOS

A Deus, por minha existência e por ter-me permitido chegar até aqui, a despeito de uma pandemia em que muitos perderam suas vidas, tendo em vista que Ele é responsável por renovar, a cada manhã, minha vontade de viver e de aprender.

Ao meu pai, Washington Nunes Baratta Monteiro, que nunca mediu esforços para dar e proporcionar a mim e as minhas três irmãs tudo de melhor. Um batalhador que se formou em Medicina e sempre me ensinou que podemos chegar aonde quisermos, se tivermos determinação, afinal "ninguém tem dois cérebros". Sua competência me orgulha e serve de exemplo a ser seguido. Segui seus conselhos de cursar Odontologia e fazer especialização em Ortodontia. Esta conquista se deve, em grande parte, a ele. Obrigada por me ensinar o valor que o estudo tem!

A minha mãe, Ester Mirna Levi Baratta Monteiro, que, praticamente, renunciou a sua vida, trancando uma faculdade que sempre desejou fazer, para se dedicar a mim e as minhas irmãs desde o primeiro instante em que viemos ao mundo, torcendo e vibrando com cada vitória nossa; maior exemplo de amor não há. Uma mulher guerreira, que venceu um câncer e ainda encontrou força e motivação para seguir em frente. Sou eternamente grata a Deus pelo privilégio de ser sua filha!

A minha irmã Cynthia, por ser fonte de admiração e inspiração para mim, pois, apesar de bem mais nova do que eu, tornou-se mestra e doutora em Medicina Veterinária. Agradeço, também, às minhas outras duas irmãs, Bruna a Diana, que me fazem refletir como viver de maneira mais leve. Obrigada a cada uma de vocês por podermos caminhar juntas e completar as vidas uma da outra!

Ao meu esposo Pedro César, que sempre me incentivou e me ensinou tanto. Grande parte dos conhecimentos em Ortodontia que tenho hoje devo a ele. Sou-lhe grata porque em momentos que achava que não iria conseguir, ele foi otimista e fez-me acreditar que ia dar certo. Gratidão porque ele realmente me suportou durante todo este trabalho!

Aos meus filhos Marina, Mirela e João Pedro, por terem torcido tanto que este dia chegasse e por terem compreendido que minha ausência, em vários momentos, não era uma vontade minha, mas uma necessidade.

Aos professores do Programa de Pós-Graduação em Odontologia da Faculdade de Farmácia, Odontologia e Enfermagem da Universidade Federal do Ceará, por todos os ensinamentos recebidos durante estes anos, assim como pela oportunidade de realizar o doutorado nessa universidade em que iniciei minha formação e pude também fazer o mestrado.

Ao meu orientador, Prof. Dr. José Jeová Siebra Neto, de quem fui aluna já na graduação. Seu dom de ensinar e tratar pacientes são exemplo não apenas para mim, mas para todos os alunos que têm o privilégio de conviver com ele. Do fundo do coração, agradeço por todas as oportunidades dadas a mim, desde o ingresso no doutorado até a liberdade de escolher o tema da minha pesquisa. Obrigada por poder conviver e aprender com uma pessoa tão admirável!

A minha aluna do Curso de Especialização em Ortodontia da ABO-CE, Ana Carolina de Figueiredo Costa, a qual foi mais do que uma parceira no artigo da revisão sistemática que compõe parte desta tese; uma pessoa tranquila, com quem pude contar sempre que precisei, e que contribuiu muito para que eu pudesse apresentar este trabalho.

Ao Prof. Dr. Paulo Goberlânio de Barros Silva, que, ao ser convidado a participar deste trabalho, prontamente, mostrou-se disposto a contribuir com seus conhecimentos em Estatística, em um dos capítulos desta tese.

Ao colega Hermano Camelo Paiva, que, estando na Universidade de São Paulo, no curso de doutorado em Endodontia, dispendeu seu tempo para ir até a biblioteca buscar alguns artigos importantes para o meu trabalho, apesar de nos conhecermos pouco.

Aos professores participantes da banca examinadora da pré-defesa, Prof. Dr. Lucas Guimarães Abreu e Prof. Dr. Bernardo Quiroga Souki, pelo tempo dispendido com a leitura e pelas valiosas colaborações e sugestões.

Aos colegas da turma de doutorado, especialmente à Fabiola Nogueira, pela parceria durante todo este período; por se preocupar, a cada início de semestre, em saber se eu tinha feito a matrícula; pelos trabalhos que realizamos juntas em cada disciplina ou nos atendimentos clínicos.

A todos os funcionários do Curso de Odontologia da Universidade Federal do Ceará, principalmente Martinha e Dona Leuda, sempre solícitas e empenhadas em fazer o atendimento aos pacientes acontecer da melhor forma possível.

Aos secretários do Programa de Pós-Graduação em Odontologia da Universidade Federal do Ceará, Joana Karla de Assis Pinheiro e Rafael Maia Reis, pela cordialidade e disponibilidade de sempre, além da eficiência no serviço prestado.

A todos os pacientes participantes desta pesquisa e seus responsáveis, sem os quais esta tese não teria sido possível.

RESUMO

No tratamento da má oclusão de Classe II/1, tanto o correto diagnóstico, como o monitoramento do controle vertical podem ser associados a resultados desejáveis. Diversas medidas cefalométricas, angulares ou lineares, são ferramentas de grande valia nesse processo. Na tentativa de conseguir alterações favoráveis ou, pelo menos, manutenção da dimensão vertical, pacientes em fase de crescimento com protrusão maxilar têm sido tratados com aparelhos extrabucais; entre os quais, está o aparelho de Thurow modificado (TM). Com o objetivo de explorar este assunto, o presente trabalho dividiu-se em duas partes. Na primeira, foi realizado um estudo retrospectivo para verificar se o uso de diferentes medidas cefalométricas teria influência na determinação do padrão facial. Utilizou-se uma amostra com telerradiografias cefalométricas laterais pré (T1) e pós-tratamento (T2), de 27 indivíduos em fase de crescimento, com má oclusão de Classe II/1, tratados com TM. Após o escaneamento das imagens, os padrões faciais desses pacientes foram estabelecidos com base em medidas de quatro análises cefalométricas distintas. Em seguida, os resultados apontados por cada análise foram comparados entre T1 e T2 pelo teste qui-quadrado de Pearson ou exato de Fisher e a concordância entre as análises foi verificada por meio do teste de McNemar e do coeficiente de concordância kappa (k). Observou-se que apenas uma medida mostrou variações significativas entre T1 e T2 ($p = 0,026$), ao passo que, quando cada método foi avaliado em relação aos demais, a maioria apresentou diferença estatisticamente significante ($p < 0,001$), além de correlações inexistentes ou mínimas ($k < 0$ ou $0 < k \leq 0,20$, respectivamente). Concluiu-se que o padrão facial de pacientes Classe II/1 foi avaliado de forma não homogênea, quando do emprego de diferentes medidas cefalométricas, em especial aquelas que utilizam apenas parâmetros da região anterior ou posterior. Na segunda parte do trabalho, foi realizada uma revisão sistemática com o objetivo de investigar os efeitos dentoesqueléticos do TM, no tratamento da Classe II/1 de pacientes hiperdivergentes em fase de crescimento. Após seleção dos estudos e aplicação dos critérios de elegibilidade, 7 artigos foram incluídos na pesquisa, para extração de dados e análise. A literatura avaliada revelou que o uso desse dispositivo proporciona: (1) inibição do desenvolvimento vertical da maxila, principalmente na região posterior, com rotação anti-horária da mandíbula; (2) manutenção do padrão facial; (3) redução significativa da sobressaliência; (4) melhora da relação interincisal e (5) estabelecimento da relação molar de Classe I. No entanto, ensaios clínicos adicionais de melhor qualidade são necessários para elucidar os reais efeitos dessa terapia no padrão de crescimento desses pacientes.

Palavras-chave: má oclusão Classe II de Angle Divisão 1; aparelhos de tração extrabucal; cefalometria; dimensão vertical.

ABSTRACT

In the treatment of Class II/1 malocclusion, both the correct diagnosis and the monitoring of the vertical control can be associated with desirable results. Several cephalometric measurements, angular or linear, are very valuable tools in this process. In an attempt to achieve favorable changes or, at least, maintenance of the vertical dimension, patients in the growth phase with maxillary protrusion have been treated with headgear; including the modified Thurow appliance (MTA). In order to explore this issue, the present research was divided into two parts. In the first one, a retrospective study was carried out to verify whether the use of different cephalometric measurements would influence the determination of the facial pattern. It was used a sample with pre (T1) and post-treatment (T2) lateral cephalograms of 27 individuals in the growth phase, with Class II/1 malocclusion, treated with MTA. After scanning the images, the facial patterns of these patients were established based on measurements from four different cephalometric analyses. Then, the results indicated by each analysis were compared between T1 and T2 using Pearson's chi-square test or Fisher's exact test and the agreement between the analyses was verified using the McNemar test and the Kappa method (k). It was observed that only one measure showed significant variations between T1 and T2 ($p = 0,026$), while when each method was evaluated in relation to the others, the vast majority showed a statistically significant difference ($p < 0,001$), in addition to correlations non-existent or minimal ($k < 0$ or $0 < k \leqslant 0,20$, respectively). It was concluded that the facial pattern of Class II/1 patients was evaluated in a non-homogeneous way, when using different cephalometric measurements, especially those that use only parameters of the anterior or posterior region. In the second part of the research, a systematic review was carried out in order to investigate the dentoskeletal effects of the TM in the treatment of the Class II/1 hyperdivergent patients in the growth phase. After selecting the studies and applying the eligibility criteria, 7 articles were included in the study, for data extraction and analysis. The literature evaluated revealed that the use of this device provides: (1) inhibition of the vertical development of the maxilla, mainly in the posterior region, with counterclockwise rotation of the mandible; (2) maintenance of the facial pattern; (3) significant reduction in the overjet; (4) improvement of the interincisal relationship and (5) establishment of the Class I molar relationship. However, additional clinical trials of better quality are needed to elucidate the real effects of this therapy on the growth pattern of these patients.

Keywords: Class II malocclusion, Division 1; extraoral traction appliances; cephalometry;

vertical dimension.

SUMÁRIO

1 INTRODUÇÃO 11

2 PROPOSIÇÃO 13

2.1 Objetivos gerais 13

2.2 Objetivos específicos 13

3 CAPÍTULOS 14

3.1 Capítulo 1. "Comparação de diferentes análises cefalométricas utilizadas na avaliação do padrão facial de pacientes Classe II/1, após tratamento com aparelho de Thurow modificado" 15

3.2 Capítulo 2. "The effects of modified Thurow appliance on facial pattern of growing hyperdivergent Class II patients: a systematic review of clinical studies" 34

4 CONCLUSÃO 60

REFERÊNCIAS 61

ANEXO A - PARECER CONSUBSTANCIADO DO CEP 64

ANEXO B - DIRETRIZES PARA PUBLICAÇÃO NA REVISTA DENTAL PRESS JOURNAL ORTHODONTICS 65

ANEXO C - DIRETRIZES PARA PUBLICAÇÃO NA REVISTA PROGRESS IN ORTHODONTICS 69

1 INTRODUÇÃO

A má oclusão de Classe II é definida por uma relação distal da mandíbula com a maxila, podendo ser de origem esquelética, com protrusão maxilar e/ou retrusão mandibular (ROSENBLUM, 1995; MCNAMARA et al., 1996), ou dentária, quando os dentes inferiores estão posicionados distalmente aos dentes superiores (ANGLE, 1899). É considerada um problema relevante, pois, além de poder comprometer as funções mastigatória e respiratória, pode, também, interferir na qualidade de vida das pessoas, devido à influência na estética da face e do sorriso (BERNABÉ et al., 2008; SEEHRA et al., 2011; FREJMAN et al., 2013).

O diagnóstico correto é de suma importância para a elaboração de um plano de tratamento adequado (GEBECK; MERRIFIELD, 1995). Neste contexto, a cefalometria constitui-se uma importante ferramenta, pois é capaz de auxiliar o entendimento de como estruturas ósseas, tecidos dentários e moles influenciam a formação da má oclusão (MCNAMARA et al., 1996; BISHARA, 2006); possibilitar a obtenção de dados relacionados às mudanças ocorridas ao final do tratamento, nos sentidos sagital e vertical (BAUMRIND et al., 1983); permitir ao ortodontista determinar se a dimensão vertical está sendo controlada durante a realização da mecânica adotada, o que seria um ponto crucial para o sucesso da terapia (HORN, 1992), principalmente no caso de pacientes hiperdivergentes. Por isso, é essencial que o ortodontista saiba utilizar as análises cefalométricas, estando apto a interpretar grandezas angulares e/ou lineares.

No universo ortodôntico, podem ser encontrados inúmeros trabalhos que utilizam a cefalometria para estudar as alterações dentoesqueléticas e os efeitos no padrão facial de indivíduos Classe II em crescimento (CALDWELL, 1984; SEÇKIN; SURUCU, 1990; ÜNER; YÜCEL-EROGLU, 1996; PITHON et al., 2014; JACOB et al., 2014; SILVESTRINI-BIAVATI et al., 2020; MIGUEL et al., 2020). No entanto, esses estudos se concentram em avaliar as mudanças pós-tratamento, sem levar em consideração as grandezas cefalométricas utilizadas nesta avaliação. Consequentemente, a literatura carece de trabalhos que abordem a comparação entre diferentes medidas.

Considerando a idade do paciente (BACCETTI et al., 1997), a natureza da desarmonia (SEÇKIN; SURUCU, 1990) e os maxilares envolvidos (maxila e/ou mandíbula) (ROSENBLUM, 1995; MCNAMARA et al., 1996), o tratamento pode ser realizado de diversas maneiras (MCNAMARA et al., 1996; BISHARA, 2006; ALMEIDA-PEDRIN et al., 2007; FERNANDES et al., 2010; FONTES et al., 2020). No entanto, durante o planejamento e a

execução da mecânica escolhida, é imprescindível também considerar a dimensão vertical do paciente, pois, apesar de se esperar que a terapia seja benéfica, esta pode, pelo contrário, levar a alterações prejudiciais ao padrão facial (CREEKMORE, 1967; MELSEN, 1978; BAUMRIND et al., 1981).

Normalmente, indivíduos que apresentam protrusão óssea maxilar e ainda estão em crescimento são tratados com aparelhos extrabucais para eliminar ou reduzir a discrepância sagital (ALMEIDA-PEDRIN et al., 2007; SILVESTRINI-BIAVATI et al., 2020; MIGUEL et al., 2020). Nos casos em que, além da relação anteroposterior inadequada, observa-se um padrão dolicofacial, com aumento da altura facial anterior (AFA), falta de selamento labial passivo e rotação horária da mandíbula com aumento do ângulo do plano mandibular, o controle vertical do crescimento maxilar faz-se necessário durante o tratamento (FOTIS et al., 1984; GARBUI et al., 2010; DEL SANTO et al., 2016).

Em 1975, Thurow publicou um aparelho extrabucal combinado a uma placa acrílica com cobertura oclusal de todos os dentes superiores erupcionados, o qual chamou de “splint maxilar”. Seu objetivo era restringir o crescimento da maxila, enquanto permitia que a mandíbula girasse no sentido anti-horário. Ademais, a cobertura acrílica desocluía os dentes, eliminando possíveis interferências oclusais durante a aplicação da força, facilitando a distalização dos dentes superiores e a correção dos deslocamentos mandibulares funcionais (THUROW, 1975).

Desde então, outros pesquisadores fizeram modificações no desenho original, resultando no que poderia ser chamado de aparelho de Thurow modificado (TM) (JOFFE, JACOBSON, 1979; HENRIQUES et al., 1991; SANTOS-PINTO et al., 2001). Essa alternativa de tratamento tem sido amplamente aceita e utilizada na correção da Classe II/1 esquelética em indivíduos em crescimento, pois, apesar dos diferentes desenhos, é capaz de atuar na restrição do desenvolvimento maxilar, tanto horizontal, quanto verticalmente (FIROUZ et al., 1992; STUANI et al., 2005; MARTINS et al., 2008; PITHON et al., 2014).

Os efeitos dentoesqueléticos do uso do TM constam em um vasto número de pesquisas (CALDWELL, 1984; SEÇKIN; SURUCU, 1990; ÜNER; YÜCEL-EROGLU, 1996; STUANI et al., 2005; MARTINS et al., 2008; PITHON et al., 2014; MIGUEL et al., 2020). Contudo, em relação aos verdadeiros efeitos desse dispositivo no padrão facial de pacientes hiperdivergentes, a literatura é bastante escassa, apesar da grande relevância clínica. Sendo esta terapia capaz de intervir na direção de crescimento da face, o ortodontista teria uma ferramenta importante para o tratamento de pacientes com esse padrão.

2 PROPOSIÇÃO

Esta tese de doutorado é apresentada em dois capítulos e tem como objetivos:

2.1 Objetivo Geral

Estudar os efeitos do TM no padrão facial de pacientes Classe II/1 em crescimento, de acordo com diferentes medidas cefalométricas, assim como investigar a influência deste dispositivo no tratamento desta má oclusão, em indivíduos hiperdivergentes.

2.2 Objetivos Específicos

1. Verificar se a utilização de diferentes medidas cefalométricas interfere na determinação do padrão facial de indivíduos Classe II/1 em fase de crescimento, tratados com o TM;

2. Investigar possíveis alterações no padrão facial de indidíduos hiperdivergentes, após a utilização do TM no tratamento da Classe II/1;

3. Investigar os efeitos do TM na mordida aberta, em indivíduos Classe II/1 hiperdivergentes;

4. Investigar os efeitos do TM na sobressaliência, em indivíduos Classe II/1 hiperdivergentes;

5. Investigar os efeitos do TM na verticalização de incisivos, em indivíduos Classe II/1 hiperdivergentes;

6. Investigar possíveis alterações nas relações sagitais entre molares e/ou bases ósseas de indivíduos hiperdivergentes, após a utilização do TM no tratamento da Classe II/1.

3 CAPÍTULOS

Esta tese baseia-se no Artigo 46 do Regimento do Programa de Pós-Graduação em Odontologia, da Universidade Federal do Ceará, que regulamenta o formato alternativo para dissertações de mestrado e teses de doutorado e permite a inserção de artigos científicos de autoria e coautoria do candidato. Por se tratar de pesquisa envolvendo seres humanos, o projeto de pesquisa deste trabalho foi submetido à apreciação do Comitê de Ética em Pesquisa da Universidade Federal do Ceará, obtendo a aprovação sob o número de protocolo 043/2011 (ANEXO A), uma vez que obedece aos ditames da Resolução N° 466/2012 do Conselho Nacional de Saúde, Ministério da Saúde-Brasil. Desse modo, esta tese é composta por dois capítulos, contendo um artigo cada um, conforme descrito abaixo:

CAPÍTULO 1: "Comparação de diferentes análises cefalométricas utilizadas na avaliação do padrão facial de pacientes Classe II/1, após tratamento com aparelho de Thurow modificado". Este artigo será submetido à publicação no periódico Dental Press Journal of Orthodontics (ANEXO B).

CAPÍTULO 2: "The effects of modified Thurow appliance on facial pattern of growing hyperdivergent Class II patients: a systematic review of clinical studies". Este artigo foi submetido à publicação no periódico Progress in Orthodontics (ANEXO C).

3.1 Capítulo 1

Comparação de diferentes análises cefalométricas utilizadas na avaliação do padrão facial de pacientes Classe II/1, após tratamento com aparelho de Thurow modificado

Aline Levi Baratta Monteiro[a], DDS, MSc; Paulo Goberlânio de Barros Silva[b] DDS, MSc, PhD; Lucio Mitsuo Kurita[c], DDS, MSc, PhD; Pedro Cesar Fernandes dos Santos[c] DDS, MSc, PhD; José Jeová Siebra Moreira Neto[c], DDS, MSc, PhD.

[a]Estudante de Pós-Graduação em Odontologia. Faculdade de Farmácia, Odontologia e Enfermagem - Universidade Federal do Ceará, Fortaleza - Ceará- Brasil.
[b]Professor do Programa de Pós-graduação em Odontologia da Universidade Federal do Ceará, Fortaleza- Ceará - Brasil.
[c] Professor do Departamento de Clínica Odontológica. Faculdade de Farmácia, Odontologia e Enfermagem - Universidade Federal do Ceará, Fortaleza- Ceará - Brasil.

Endereço para correspondência:
Aline Levi Baratta Monteiro
Faculdade de Farmácia, Odontologia e Enfermagem
Departamento de Clínica Odontológica
Rua Monsenhor Furtado S/N
Fortaleza, Ceará, BR 60020-181
E-mail: alinebaratta@yahoo.com.br
Telefone: +55 85 3366.8232

Título: Comparação de diferentes análises cefalométricas utilizadas na avaliação do padrão facial de pacientes Classe II/1, após tratamento com aparelho de Thurow modificado

RESUMO

INTRODUÇÃO: A cefalometria tem papel fundamental na determinação do padrão facial e na avaliação de alterações dentoesqueléticas após o tratamento da Classe II/1.

OBJETIVOS: Verificar se a utilização de diferentes medidas cefalométricas interfere na determinação do padrão facial de indivíduos Classe II/1 em fase de crescimento, tratados com o aparelho de Thurow modificado.

MÉTODOS: Os padrões faciais de 27 indivíduos (16 sexo masculino, 11 sexo feminino; média de idade 9,0 ± 1,33 anos) Classe II/1 foram determinados no início (T1) e no final (T2) do tratamento, de acordo com VERT de Ricketts, Ar-PM/PP-Me (IAF), S-Go/N-Me (PAF) e N-Me (AFAT), ENA'-Me (AFAI) e N-ENA' (AFAS), e, em seguida, comparados. A frequência em T1 e T2 foi avaliada pelo teste qui-quadrado de Pearson ou exato de Fisher e a concordância entre as medidas por meio do teste de McNemar e do coeficiente de concordância kappa (k).

RESULTADOS: Apenas a AFAT mostrou diferença significativa entre T1 e T2. O VERT apresentou diferença significativa da PAF e das AFAT, AFAI e AFAS, com concordância razoável e mínima, respectivamente. A PAF mostrou-se significativamente diferente do IAF e da AFAT e AFAS, concordando, moderadamente, com o primeiro e, minimamente, com as últimas. O IAF diferiu da AFAT, AFAI e AFAS, não apresentando correlação alguma com qualquer uma delas.

CONCLUSÕES: O padrão facial de pacientes Classe II/1 foi avaliado de forma não homogênea, quando do emprego de diferentes medidas cefalométricas, em especial, aquelas que utilizam apenas parâmetros da região anterior ou posterior.

Palavras-chave: Má Oclusão Classe II de Angle Divisão 1. Cefalometria. Aparelhos de Tração Extrabucal. Comparabilidade dos Dados.

Title: Comparison of different cephalometric analyses used to assess the facial pattern of Class II/1 patients, after treatment with the modified Thurow appliance

ABSTRACT

INTRODUCTION: Cephalometry has a fundamental role in determining the facial pattern and in the evaluation of dentoskeletal changes after Class II/1 treatment.

OBJECTIVES: To verify if the use of different cephalometric measurements interferes in the determination of the facial pattern of Class II/1 individuals in the growth phase, treated with the modified Thurow appliance.

METHODS: Facial patterns of 27 subjects (16 males, 11 females; mean age 9.0 ± 1.33 years) Class II/1 were determined at the beginning (T1) and at the end (T2) of treatment, according to Ricketts VERT, Ar-MP/PP-Me (FHI), S-Go/N-Me (FHR) and N-Me (AFH), ENA'-Me (LFH) and N-ENA' (UFH), and then compared. Frequency at T1 and T2 was assessed using Pearson's chi-square test or Fisher's exact test and the agreement between the analyses using the McNemar test and the Kappa method (k).

RESULTS: Only AFH showed difference between T1 and T2. A significant difference was observed between VERT and FHR and between VERT and AFH, LFH and UFH, with reasonable and minimal agreement, respectively. The FHR was significantly different from the FHI and from the AFH and UFH, agreeing moderately with the first and minimally with the latter. The FHI differed from the AFH, LFH and UFH, not showing any correlation with any of them.

CONCLUSIONS: It was concluded that the facial pattern of Class II/1 patients was evaluated in a non-homogeneous way, when using different cephalometric measurements, especially those that use only parameters of the anterior or posterior region

Keywords: Class II Malocclusion, Division 1. Cephalometry. Extraoral Traction Appliances. Data Comparability.

1. INTRODUÇÃO

A má oclusão de Classe II pode ser considerada um problema relevante, pois, além de poder comprometer as funções mastigatória e respiratória, pode, também, interferir na qualidade de vida das pessoas, devido à influência na estética da face e do sorriso.[1-3] Enquanto isso, a aceitação do padrão facial tem sido investigada, podendo-se observar que está diretamente relacionada à direção do crescimento, embora dependa, também, de quem está julgando.[4-6]

Seu diagnóstico é realizado por meio de exame clínico, em conjunto com análises facial, cefalométrica e de modelos. Considerando a idade do paciente[7], a natureza da desarmonia[8] e os maxilares envolvidos,[9, 10] o tratamento pode ser realizado de diversas maneiras.[10-14] Entretanto, durante o planejamento e a execução da mecânica escolhida, é imprescindível levar em consideração a dimensão vertical do paciente, pois, apesar de a intervenção no padrão facial de indivíduos em crescimento poder ser benéfica,[15, 16] pode, por outro lado, levar a alterações prejudiciais ao resultado da terapia.[17-19] Portanto, a importância da elaboração de um plano de tratamento adequado implica uma grande responsabilidade ao ortodontista de diagnosticar corretamente não só a má oclusão, mas também o padrão de crescimento da face.[20]

Os recursos diagnósticos têm oferecido, cada vez mais, melhores condições de se alcançar este objetivo. A cefalometria constitui-se como uma importante ferramenta nesse processo, pois é capaz de auxiliar o entendimento de como estruturas ósseas, tecidos dentários e moles influenciam a formação da má oclusão;[10, 11] possibilitar a obtenção de dados relacionados às mudanças ocorridas ao final do tratamento, nos sentidos anteroposterior e vertical;[21] permitir ao ortodontista determinar se a dimensão vertical está sendo controlada durante a realização da mecânica adotada, o que seria um ponto crucial para o sucesso da terapia.[22]

A análise no sentido vertical possui grande importância pela relação que as bases maxilares têm entre si. Assim como o controle do crescimento vertical do complexo nasomaxilar pode implicar a rotação mandibular no sentido anti-horário,[23, 24] a utilização de aparelhos que promovem ou permitem a extrusão de molares superiores pode ocasionar a rotação da mandíbula em sentido contrário,[18] levando ao aumento da dimensão vertical da face. Portanto, dependendo do padrão de crescimento do paciente, pode ser necessária, por exemplo, a manutenção do controle vertical durante a extensão de todo o tratamento,[16] para não levar à piora desse padrão facial.

Neste contexto, fica claro o quão importante é o ortodontista saber utilizar as análises cefalométricas, as quais consistem da interpretação de grandezas angulares e/ou lineares. No universo ortodôntico, podem ser encontrados inúmeros trabalhos que relatam alterações dentoesqueléticas e efeitos no padrão facial de indivíduos em crescimento, com protrusão maxilar, tratados com aparelho de Thurow modificado.[8, 15, 25-29] No entanto, estes estudos se concentram em analisar as mudanças pós-tratamento, sem considerar as grandezas cefalométricas utilizadas nessa avaliação. Com base nisso, o presente trabalho teve como objetivo verificar se a utilização de diferentes medidas cefalométricas interfere na determinação do padrão facial de indivíduos Classe II em fase de crescimento, tratados com o aparelho de Thurow modificado.

HIPÓTESE NULA

Não há diferença em se utilizar diferentes medidas cefalométricas relacionadas ao padrão facial, em sua determinação.

2. MATERIAL E MÉTODOS

Esta pesquisa consiste em um estudo cefalométrico longitudinal retrospectivo, aprovado pelo Comitê de Ética em Pesquisa em Seres Humanos, sob Protocolo 043/11.

A amostra consistiu de 54 telerradiografias cefalométricas laterais (pré-tratamento e pós-tratamento) de 27 indivíduos com má oclusão de Classe II/1 (16 do sexo masculino e 11 do feminino), tratados com aparelho de Thurow modificado. No pré-tratamento, a média de idade foi de 9,0 ± 1,33 anos, enquanto, no pós-tratamento, a média de idade foi de 11,1 ± 1,84 anos. Os critérios de elegibilidade para a seleção da amostra foram: 1) presença de má oclusão de Classe II avaliada pelo ângulo ANB > 4º e pela análise de modelos de estudo, de acordo com a classificação de Angle; 2) sobressaliência > 5mm; 3) ausência de dentes supranumerários ou agenesias; 4) indivíduos que possuíam registro completo das documentações ortodônticas iniciais e finais. Os critérios de exclusão foram crianças com síndromes, presença de lesões de cárie e/ou doença periodontal e falta de colaboração durante o tratamento.

Como o desfecho primário desta investigação é o padrão vertical dos pacientes tratados com TM, o cálculo do tamanho da amostra foi realizado com base na medida FMA, considerando os desvios-padrão pré e pós-tratamento, para homens (3,33 vs 3,92) e mulheres (3,66 vs 4,38)[16]. A análise foi feita com os testes da família t para comparação de médias de um

mesmo grupo de pacientes, com uma tolerância clínica de 3º entre as medidas, um nível de significância de 5% e um poder de 95%. Estimou-se ser necessária uma amostra mínima de 26 indivíduos tendo como base os dados das mulheres, e de 22 indivíduos os dados dos homens.

O tratamento foi realizado com o aparelho extrabucal de Thurow modificado[30], consistindo de dois momentos: fase ativa e fase de contenção. A primeira teve duração mínima de 6 meses e aconteceu até a verificação da sobrecorreção da Classe II, com os primeiros molares superiores ocluindo distalmente em relação ao primeiro molar inferior. Durante essa fase, foi utilizado aparelho extrabucal associado a um casquete regulável de Interlandi (Morelli®, Sorocaba, SP, Brasil), o qual permitia que a força de 350 a 400g/lado passasse o mais próximo possível do centro de resistência da maxila. Os pacientes foram instruídos a utilizar o dispositivo por, no mínimo, 14 horas/dia. Posteriormente, na fase de contenção, a qual teve duração de 6 meses, a instrução foi para que o uso ocorresse durante 8 horas noturnas. O tempo médio de tratamento foi de 2,09 ± 1,18 anos.

As telerradiografias laterais incluídas no estudo foram obtidas no início (T1) e imediatamente após o final da terapia (T2). Sua realização ocorreu de forma padronizada, com o plano de Frankfurt paralelo ao solo, respeitando os cuidados na execução da técnica radiográfica apropriada e levando em consideração os fatores de radioproteção, tanto do operador quanto dos indivíduos submetidos ao exame radiográfico. Todas foram realizadas no mesmo cefalostato e aparelho de raios X, em norma lateral direita e oclusão cêntrica, pelo mesmo operador. Por meio do programa de digitalização da HP SCANJET G4050, foram digitalizadas, e foi confeccionado, então, o desenho anatômico. Em seguida, um radiologista experiente e calibrado utilizou um cursor de mira, com o auxílio de um "*mouse*", para estabelecer, no programa Radiocef Studio©, pontos cefalométricos clássicos (S , N, ENA, ENP, Me, Go, Ar, Ba, Pt, Gn, Pog) e um ponto construído (ENA'), a fim de possibilitar o traçado das linhas e dos planos relacionados às seguintes medidas: VERT;[31] IAF;[22, 32] PAF[33] e AFAT, AFAS, AFAI[34] (Fig 1 a 4).

Os parâmetros adotados por cada análise,[35] para definição do padrão facial de cada paciente em T1 e T2, encontram-se na Tabela 1. Na análise de Wylie e Johnson (1952), o paciente foi classificado como braqui, meso ou dolicofacial, quando duas ou mais medidas apontavam para um desses padrões. Após essa determinação, as quatro análises foram comparadas entre si.

Tabela 1: Parâmetros adotados para definição do padrão facial dos pacientes.

	BRAQUIFACIAL	MESOFACIAL	DOLICOFACIAL

Ricketts[31]	VERT ≥ +0,5	-0,5 < VERT < +0,5	VERT ≤ -0,5
Gebeck, Merrifield[32] e Horn[22]	IAF ≥ 74%	64% < IAF < 74%	IAF ≤ 63%
Siriwat, Jarabak[33]	PAF ≥ 63%	59% < PAF < 63%	PAF ≤ 59%
	AFAT < 108mm	108mm ≤ AFAT ≤ 120mm	AFAT > 120mm
Wylie, Johnson[34]	AFAS < 47mm	47mm ≤ AFAS ≤ 55mm	AFAS > 55mm
	AFAI < 57mm	57mm ≤ AFAI ≤ 69mm	AFAI > 69mm

IAF: Índice da Altura Facial = (Ar-PM/ PP-Me) x 100; PAF: Proporção da Altura Facial ou Quociente de Jarabak = (S-Go/N-Me) x 100; AFAT: Altura Facial Anterior Total = N-Me; AFAS: Altura Facial Anterior Superior = N-ENA'; AFAI: Altura Facial Anterior Inferior = ENA'-Me.

ANÁLISE ESTATÍSTICA DOS DADOS

Os dados foram tabulados no Microsoft Excel e exportados para o software Statistical Package for the Social Sciences no qual foram analisados com uma confiança de 95%. A frequência do padrão facial em T1 e T2 foi avaliada pelo teste qui-quadrado de Pearson ou exato de Fisher e a concordância entre os métodos de avaliação por meio do teste de McNemar e do coeficiente de concordância kappa (k).

3. RESULTADOS

Os dados relacionados à avaliação do padrão facial em T1 e T2, de acordo com as quatro diferentes análises cefalométricas, encontram-se na Tabela 2. Como pode ser observado, no início do tratamento, o VERT, a PAF e o IAF indicaram que a maioria dos pacientes tinha padrão dolicofacial, enquanto as demais medidas apontaram padrão meso/braquifacial. Além disso, apenas a AFAT mostrou variações significativas do padrão facial, entre T1 e T2 (p = 0,026).

Tabela 2: Frequência do padrão facial em T1 e T2, de acordo com as medidas das quatro análises.

	Frequência				p-Valor
	T1		T2		
VERT					
Dolicofacial	22	81,5%	19	70,4%	0,340
Meso/Braquifacial	5	18,5%	8	29,6%	
PAF (JARABAK)					
Dolicofacial	17	63,0%	14	51,9%	0,409
Meso/Braquifacial	10	37,0%	13	48,1%	
IAF (GEBECK)					
Dolicofacial	23	85,2%	20	74,1%	0,311
Meso/Braquifacial	4	14,8%	7	25,9%	
WYLIE & JOHNSON					

AFAT					
Dolicofacial	10*	37,0%	3	11,1%	*0,026*
Meso/Braquifacial	17	63,0%	24*	88,9%	
AFAI					
Dolicofacial	9	33,3%	12	44,4%	0,402
Meso/Braquifacial	18	66,7%	15	55,6%	
AFAS					
Dolicofacial	9	33,3%	11	40,7%	0,573
Meso/Braquifacial	18	66,7%	16	59,3%	

*p < 0,05, teste exato de Fisher ou qui-quadrado de Pearson.

Quando as análises cefalométricas foram comparadas entre si (Tab 3 a 8), observou-se que o VERT apresentou diferença significativa da PAF (p = 0,021) e das AFAT, AFAI e AFAS (p < 0,001), enquanto a PAF mostrou-se significativamente diferente do IAF (p = 0,002), da AFAT (p < 0,001) e da AFAS (p = 0,043). Verificou-se, ainda, que o IAF diferiu das três medidas de Wylie e Johnson (AFAT, AFAI e AFAS) (p < 0,001). Além disso, constatou-se a existência de correlações inexistentes ou mínimas (k < 0 ou 0 < k ≤ 0,20, respectivamente) entre a maioria das medidas.

Tabela 3: Relação do VERT com as outras análises cefalométricas do estudo.

	VERT					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
PAF (JARABAK)						
Dolicofacial	28	68,3%	3	23,1%	*0,021*	0,358
Meso/Braquifacial	13	31,7%	10	76,9%		
IAF (GEBECK)						
Dolicofacial	34	82,9%	9	69,2%	0,804	0,145
Meso/Braquifacial	7	17,1%	4	30,8%		
WYLIE E JOHNSON						
AFAT						
Dolicofacial	12	29,3%	1	7,7%	*<0,001*	0,124
Meso/Braquifacial	29	70,7%	12	92,3%		
AFAI						
Dolicofacial	16	39,0%	5	38,5%	*<0,001*	0,004
Meso/Braquifacial	25	61,0%	8	61,5%		
AFAS						
Dolicofacial	16	39,0%	4	30,8%	*<0,001*	0,053
Meso/Braquifacial	25	61,0%	9	69,2%		

*p < 0,05, teste de McNemar

Tabela 4: Relação da PAF com as outras análises cefalométricas do estudo.

	PAF (JARABAK)					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
VERT						
Dolicofacial	28	90,3%	13	56,5%	*0,021*	0,358
Meso/Braquifacial	3	9,7%	10	43,5%		
IAF (GEBECK)						
Dolicofacial	30	96,8%	13	56,5%	*0,002*	0,432
Meso/Braquifacial	1	3,2%	10	43,5%		
WYLIE e JOHNSON						
AFAT						
Dolicofacial	10	32,3%	3	13,0%	*<0,001*	0,175
Meso/Braquifacial	21	67,7%	20	87,0%		
AFAI						
Dolicofacial	14	45,2%	7	30,4%	0,064	0,139
Meso/Braquifacial	17	54,8%	16	69,6%		
AFAS						
Dolicofacial	13	41,9%	7	30,4%	*0,043*	0,108
Meso/Braquifacial	18	58,1%	16	69,6%		

*p < 0,05, teste de McNemar

Tabela 5: Relação do IAF com as outras análises cefalométricas do estudo.

	IAF (GEBECK)					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
VERT						
Dolicofacial	34	79,1%	7	63,6%	0,804	0,145
Meso/Braquifacial	9	20,9%	4	36,4%		
PAF (JARABAK)						
Dolicofacial	30	69,8%	1	9,1%	*0,002*	0,432
Meso/Braquifacial	13	30,2%	10	90,9%		
WYLIE e JOHNSON						
AFAT						
Dolicofacial	10	23,3%	3	27,3%	*<0,001*	-0,020
Meso/Braquifacial	33	76,7%	8	72,7%		
AFAI						
Dolicofacial	16	37,2%	5	45,5%	*<0,001*	-0,047
Meso/Braquifacial	27	62,8%	6	54,5%		
AFAS						
Dolicofacial	14	32,6%	6	54,5%	*<0,001*	-0,124
Meso/Braquifacial	29	67,4%	5	45,5%		

*p < 0,05, teste de McNemar

Tabela 6: Relação da AFAT com as outras análises cefalométricas do estudo.

	AFAT					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
VERT						
Dolicofacial	12	92,3%	29	70,7%	*<0,001*	0,124
Meso/Braquifacial	1	7,7%	12	29,3%		
PAF (JARABAK)						
Dolicofacial	10	76,9%	21	51,2%	*<0,001*	0,175
Meso/Braquifacial	3	23,1%	20	48,8%		
IAF (GEBECK)						
Dolicofacial	10	76,9%	33	80,5%	*<0,001*	-0,020
Meso/Braquifacial	3	23,1%	8	19,5%		

*p < 0,05, teste de McNemar

Tabela 7: Relação da AFAI com as outras análises cefalométricas do estudo.

	AFAI					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
VERT						
Dolicofacial	16	76,2%	25	75,8%	*<0,001*	0,004
Meso/Braquifacial	5	23,8%	8	24,2%		
PAF (JARABAK)						
Dolicofacial	14	66,7%	17	51,5%	0,064	0,139
Meso/Braquifacial	7	33,3%	16	48,5%		
IAF (GEBECK)						
Dolicofacial	16	76,2%	27	81,8%	*<0,001*	-0,047
Meso/Braquifacial	5	23,8%	6	18,2%		

*p < 0,05, teste de McNemar

Tabela 08: Relação da AFAS com as outras análises do estudo.

	AFAS					
	Dolicofacial		Meso/Braquifacial		p-Valor	kappa
VERT						
Dolicofacial	16	80,0%	25	73,5%	*<0,001*	0,053
Meso/Braquifacial	4	20,0%	9	26,5%		
PAF (JARABAK)						
Dolicofacial	13	65,0%	18	52,9%	*0,043*	0,108
Meso/Braquifacial	7	35,0%	16	47,1%		
IAF (GEBECK)						
Dolicofacial	14	70,0%	29	85,3%	*<0,001*	-0,124
Meso/Braquifacial	6	30,0%	5	14,7%		

*p < 0,05, teste de McNemar

4. DISCUSSÃO

Ao se planejar um tratamento de má oclusão de Classe II/1, faz-se necessário ter muita cautela com o dispositivo e os vetores de força escolhidos, principalmente quando o paciente ainda está em crescimento, pois ambos são decisivos para a obtenção da resposta desejada. A utilização de aparelhos extrabucais inseridos diretamente em tubos associados a bandas nos molares superiores é bastante comum.[14, 18, 24, 36] Nestes casos, dependendo da direção da força,[19,21] o padrão de crescimento pode ser alterado com rotação da mandíbula no sentido horário, o que agravaria ainda mais a má oclusão existente, em pacientes hiperdivergentes. Por outro lado, a associação da força extrabucal a uma placa acrílica que desarticule a oclusão previne a extrusão de molares e incisivos superiores e propicia a rotação do plano mandibular no sentido anti-horário, favorecendo a correção da Classe II.[15,23] Uma das formas de colocar isso em prática seria a utilização do aparelho de Thurow modificado como alternativa de tratamento. Em concordância com vários outros trabalhos que abordaram tratamento da Classe II,[8, 15, 23, 26, 28, 29] essa opção foi adotada no presente estudo. Dessa maneira, o direcionamento da força extrabucal foi conduzido de modo a passar pelo centro de resistência da maxila, a fim de impedir o deslocamento natural para frente e para baixo do complexo nasomaxilar.[32]

O controle vertical deve ser fator de preocupação maior em pacientes hiperdivergentes.[16] Horn (1992) sugeriu que casos com altos valores do ângulo FMA e baixo IAF devem ser tratados com extremo cuidado, já que todas as mecânicas ortodônticas são naturalmente extrusivas. Por outro lado, na abordagem de indivíduos braquifaciais, Gandini et al. (2001) afirmaram que a extrusão dos molares superiores aumentaria a AFA, o que acabaria melhorando o padrão facial, já que o crescimento vertical excessivo do ramo mandibular, normalmente presente nesses casos, seria compensado por essa extrusão. Com base nisso, supõe-se que dificilmente este padrão seja modificado para um padrão dolicofacial, indesejado. Na presente pesquisa, o número de pacientes meso ou braquifaciais era pequeno e, caso fossem considerados separadamente, haveria uma fragmentação da amostra. A partir da premissa de que seria pouco provável que os indivíduos com crescimento horizontal sofressem com uma piora do perfil, foram unidos, em um grupo só, esses pacientes e os mesofaciais.

Diferentemente de alguns artigos que comparam os resultados de grupo(s) tratado(s) com um grupo controle,[19, 24, 27, 28, 36] este trabalho não o fez, o que poderia ser questionado ou visto como uma limitação. No entanto, não se optou por isso, pois o objetivo

não era avaliar os efeitos do Thurow modificado, mas sim investigar se as diferentes análises cefalométricas apontavam resultados semelhantes ou não.

A importância de o ortodontista saber utilizar a cefalometria merece destaque. Para avaliação do padrão de crescimento de um indivíduo, algumas grandezas angulares e lineares são comumente empregadas. Contudo, parece não ser confiável tirar conclusões com base apenas em uma dessas medidas, pois quando consideradas isoladamente, podem levar ao diagnóstico equivocado e, consequentemente, ao insucesso no resultado do tratamento. Wylie, Johnson (1952) afirmaram que os ângulos não dizem quais partes faciais são aberrantes em padrões faciais ruins e aconselharam que, para ser possível essa identificação, os ângulos sejam subtituídos por proporções entre medidas lineares. Em 1992, Horn descreveu a proporção entre a altura facial posterior (AFP) e a altura facial anterior (AFA), conhecida como IAF, além de explicar sua aplicabilidade. Mostrou, por exemplo, que dois casos com o mesmo FMA podem ter valores de IAF muito diferentes, devendo, portanto, ser tratados com sistemas de força distintos.

Com base neste contexto, na presente pesquisa, foram comparadas medidas angulares (presentes no VERT da análise de Ricketts[31]) e medidas lineares. Estas, por sua vez, foram extraídas de publicações em que os autores fizeram a proporção entre AFP e AFA, considerando apenas o complexo maxilomandibular[22,32] ou também a base craniana,[33] ou ainda de outra publicação que considerou a região anterior como umas das medidas relacionadas à dimensão vertical da face.[34]

Especificamente em relação aos resultados encontrados nesta investigação, o padrão dolicofacial predominava no início do tratamento, com uma frequência de 81,5%, 63% e 85,2%, de acordo com o VERT, a PAF e o IAF, respectivamente. Por outro lado, segundo as três medidas da análise de Wylie e Johnson (1952) (AFAT, AFAI e AFAS), a maior frequência em T1 foi de pacientes meso/braquifacial, sendo 63%, 66,7% e 66,7%, respectivamente. É possível que tal discordância seja decorrente do fato de estas análises terem sido criadas com base em diferentes parâmetros, ou seja, em indivíduos de diferentes etnias, idade, sexo etc. Além disso, o presente estudo adotou pontos de corte a partir de valores médios da AFAT, AFAS e AFAI publicados por Takahashi et al. (2005), os quais avaliaram 118 jovens brasileiros com oclusão normal. Como essa população abordada pelos autores era mais semelhante ao de nosso trabalho, optou-se por tomá-los como referência, apesar de eles terem utilizado pontos cefalométricos e medidas sugeridos por Wylie e Johnson (1952). Isso pode ter influenciado a frequência dos padrões verificados ao início do tratamento.

Quando foram comparadas as análises cefalométricas entre si (Tabelas 3 a 8), o VERT apresentou diferença significativa do PAF ($p = 0,021$) e da AFAT, AFAI e AFAS ($p < 0,001$). Em busca de tentar encontrar uma justificativa para isso, percebeu-se que, dos cinco ângulos utilizados no cálculo do VERT, três são formados por linhas localizadas no complexo maxilomandibular e recebem peso 4 na fórmula que indica o padrão facial do paciente, enquanto outros dois recebem peso menor (3) e se localizam fora do complexo maxilomandibular, embora estejam ainda bem próximos a ele. Por outro lado, a PAF consiste na proporção entre duas medidas lineares, AFP e AFA, as quais incluem pontos cefalométricos localizados na base craniana (Sela) ou próximo a ela (Násio), ou seja, fora do âmbito do complexo maxila/mandíbula. Quanto à diferença encontrada em relação às AFAT, AFAI e AFAS, suspeita-se que, como o presente estudo se concentrou somente nessas medidas de Wylie e Johnson (1952), desprezando as medidas relacionadas à região posterior da face, o resultado entre elas tenha sido distinto. Esses autores, inclusive, destacaram a necessidade do adequado comprimento do ramo mandibular para existência de um bom padrão facial.

Além disso, a PAF mostrou-se significativamente diferente do IAF ($p = 0,002$), assim como da AFAT ($p < 0,001$) e da AFAS ($p = 0,043$). Apesar de os dois primeiros serem semelhantes porque fazem proporções entre as alturas faciais posterior e anterior, a PAF não se restringe ao complexo maxilomandibular, como o segundo método. Pelo contrário, na região posterior, utiliza o ponto sela (S) localizado na base craniana e, na região anterior, considera não somente a AFAI, mas também a AFAS. Supõe-se que esta seja a causa da diferença encontrada. Para tentar explicar o contraste em relação às medidas de Wylie e Johnson (1952), deve ser considerado que, durante o crescimento e/ou tratamento ortodôntico, se a AFP aumenta mais rapidamente que a AFA, o padrão facial do paciente com má oclusão de Classe II melhora devido à rotação anti-horária da mandíbula. Por outro lado, se a AFA aumenta mais rapidamente do que a AFP, a mandíbula gira para baixo e para trás, aumentando a dimensão vertical.[22] Portanto, quando se considera apenas medidas da região anterior para se estabelecer o padrão e se compara com uma proporção que inclui também a região posterior, verificar divergência nos resultados não seria surpreendente.

Pode-se supor, inclusive, que essa mesma explicação seja responsável pela existência de diferença significativa entre o IAF e todas as três medidas de Wylie e Johnson (AFAT, AFAI e AFAS) ($p < 0,001$), uma vez que estas desprezam o crescimento ocorrido na região posterior da face, enquanto a primeira se utiliza de uma proporção entre AFP e AFA.

Do ponto de vista prático, esses resultados reforçam a necessidade de se considerar a cefalometria, e, particularmente, as análises que levam em consideração a AFP, para o

estabelecimento de um correto diagnóstico. Somente o exame clínico, ou, até mesmo, a análise facial, não são capazes de proporcionar ao ortodontista um acompanhamento do crescimento facial, com a mesma fidelidade que as análises cefalométricas. Nesses recursos, normalmente, é dada maior ênfase à AFA, além de os tecidos moles poderem "mascarar" a má oclusão e/ou os problemas ósseos envolvidos.

5. CONCLUSÃO

Diante dos resultados obtidos na presente pesquisa, pode-se concluir que o padrão facial de pacientes Classe II/1 foi avaliado de forma não homogênea, quando do emprego de diferentes medidas cefalométricas, em especial aquelas que utilizam apenas parâmetros da região anterior ou posterior

REFERÊNCIAS BIBLIOGRÁFICAS

1 Bernabé E, Sheihamb A, Oliveira CM. Condition-Specific Impacts on Quality of Life Attributed to Malocclusion by Adolescents with Normal Occlusion and Class I, II and III Malocclusion. Angle Orthod. 2008;78 (6):977-82.

2 Seehra J, Fleming PS, Newton T, DiBiase AT. Bullying in orthodontic patients and its relationship to malocclusion, self-esteem and oral health-related quality of life. J Orthod. 2011;38:247-56.

3 Frejman MW, Vargas IA, Rösing CK, Closs LQ. Dentofacial Deformities Are Associated With Lower Degrees of Self-Esteem and Higher Impact on Oral Health-Related Quality of Life: Results From an Observational Study Involving Adults. J Oral Maxillofac Surg. 2013;71:763-7.

4 Taki AA, Mohammed TH, Hamdan AM. Influence of the Smile Line on Smile Attractiveness in Short and Long Face Individuals. Int J Dent. 2017 Aug; 2017:2637148. https://doi:10.1155/2017/2637148.

5 Goulart MS, Capelozza Filho L, Conti AC, Almeida-Pedrin RR, Ladewig VM, Cardoso MA. Evaluation of facial esthetics in long-faced white Brazilian middle school students. Am J Orthod Dentofac Orthop. 2019 June;155(6):812-8.

6 Lima AP, Conti AC, Capelozza Filho L, Cardoso MA, Almeida-Pedrin RR. Influence of facial pattern in smile attractiveness regarding gingival exposure assessed by dentists and laypersons. Am J Orthod Dentofac Orthop. 2019 Feb;155(2):224-33.

7 Baccetti T, Franchi L, McNamara JA, Tollaro I. Early dentofacial features of Class II malocclusion: A longitudinal study from the deciduous through the mixed dentition. Am J Orthod Dentofac Orthop. 1997 May;111(5):502-9.

8 Seçkin Ö, Surucu R. Treatment of Class 11, division 1, cases with a maxillary traction splint. Quintessence Int. 1990;21(3):209-15.

9 Rosenblum RE. Class II malocclusion: mandibular retrusion or maxillary protrusion? Angle Orthod. 1995;65(1):49-62.

10 McNamara JA, Peterson JE, Alexander RG. Three-Dimensional Diagnosis and Management of Class II Malocclusion in the Mixed Dentition. Semin Orthod. 1996 June;2(2):114-37.

11 Bishara SE. Class II Malocclusions: Diagnostic and Clinical Considerations With and Without Treatment. Semin Orthod. 2006 Mar;12(1):11-24.

12 Almeida-Pedrin RR, Almeida MR, Almeida RR, Pinzan A, Ferreira FP. Treatment effects of headgear biteplane and bionator appliances. Am J Orthod Dentofac Orthop. 2007 Aug;132(2):191-8.

13 Fernandes AF, Brunharo IH, Quintão CC, Costa MG, Oliveira-Costa MR. Effectiveness of twin blocks and extraoral maxillary splint (Thurow) appliances for the correction of class II relationships. World J Orthod. 2010;11(3):230-5.

14 Fontes FP, Bellini-Pereira SA, Aliaga-Del-Castillo A, Patel MP, Freitas MR, Henriques JF, Janson G. Comparison of the dentoskeletal and soft tissue changes with the cervical headgear and Jones Jig followed by fixed appliances in Class II malocclusion patients: A retrospective study. Int Orthod. 2020 Sep;18(3):424-35.

15 Üner O, Yücel-Eroglu E. Effects of a modified maxillary orthopaedic splint: a cephalometric evaluation. Eur J Orthod. 1996;18:269-86.

16 Garbui IU, Nouer PR, Nouer DF, Magnani MB, Neto JS. Cephalometric assessment of vertical control in the treatment of class II malocclusion with a combined maxillary splint. Braz Oral Res. 2010 Jan-Mar;24(1):34-9.

17 Creekmore TD. Inhibition or stimulation of the vertical growth of the facial complex, its significance to treatment. Angle Orthod. 1967 Oct;37(4):285-97.

18 Melsen B. Effects of cervical anchorage during and after treatment: An implant study. Am J Orthod. 1978 May;73(5):526-40.

19 Baumrind S, Korn EL, Molthen R, West EE. Changes in facial dimensions associated with the use of forces to retract the maxilla. Am J Orthod. 1981 July;80(1):17-30.

20 Gebeck TR, Merrifield LL. Orthodontic diagnosis and treatment analysis-concepts and values: Part II. Am J Orthod Dentofac Orthop. 1995a May;107(5):541-7.

21 Baumrind S, Korn EL, Isaacson RJ, West EE, Molthen R. Quantitative analysis of the orthodontic and orthopedic effects of maxillary traction. Am J Orthod. 1983 Nov;84(5):384-98.

22 Horn AJ. Facial height index. Am J Orthod Dentofac Orthop. 1992 Aug;102(2):180-6.

23 Thurow RC. Craniomaxillary orthopedic correction with en masse dental control. Am J Orthod. 1975 Dec;68(6):601-24.

24 Firouz M, Zernik J, Nanda R. Dental and orthopedic effects of high-pull headgear in treatment of Class II, in Division 1 malocclusion. Am J Orthod Dentofac Orthop. 1992 Sep;102(3):197-205.

25 Caldwell SF, Hymas A, Timm TA. Maxillary traction splint: a cephalometric evaluation. Am J Orthod. 1984 May;85(5):376-84.

26 Pithon MM, Santos RL, Sampaio GA, Meneses IH, Coqueiro RS. Anteroposterior and vertical changes in skeletal class II patients treated with modified Thurow appliance. Braz Dent J. 2014;25(2):170-4.

27 Jacob HB, Santos-Pinto A, Buschang PH. Dental and skeletal components of Class II open bite treatment with a modified Thurow appliance. Dental Press J Orthod. 2014 Jan-Feb;19(1):19-25.

28 Silvestrini-Biavati S, Lazzarotti L, Bini S, Migliorati M, Ugolini A. Maxillary "en masse" high-pull traction in Class II division 1 subjects: which kind of skeletal outcomes does it produce? Eur J Paediatr Dent. 2020; 21:271-6.

29 Miguel JA, Masucci C, Fernandes LQ, Artese F, Franchi L, Giuntini V. Dentoskeletal effects of the maxillary splint headgear in the early correction of Class II malocclusion. Prog Orthod. 2020;21(1):1-10. https://doi.org/10.1186/s40510-020-00311-x

30 Henriques JF, Martins DR, Almeida GA, Ursi WJ. Modified maxillary splint for Class II, Division 1 treatment. J Clin Orthod. 1991;25:239-45.

31 Ricketts RM. Planning Treatment on the Basis of the Facial Pattern and an Estimate of Its Growth. Angle Orthod. 1957;27(1):14-37.

32 Gebeck TR, Merrifield LL. Orthodontic diagnosis and treatment analysis-concepts and values: Part I. Am J Orthod Dentofac Orthop. 1995b Apr;107(4):434-43.

33 Siriwat PP, Jarabak JR. Malocclusion and Facial Morphology Is there a Relatioship?: An Epidemiologic Study. Angle Orthod. 1985 Apr;55(2):127-38.

34 Wylie WL, Johnson EL. Rapid evaluation of facial dysplasia in the vertical plane. Angle Orthod. 1952 July;22(3):165-82.

35 Takahashi R, Pinzan A, Henriques JF, Freitas MR, Janson GR, Almeida RR. Análise cefalométrica comparativa das alturas faciais, anterior e posterior, em jovens brasileiros, descendentes de xantodermas e leucodermas, com oclusão normal. R Dental Press Ortodon Ortop Facial. 2005 Nov/Dec;10(6):42-58.

36 Rosa AJ, Nascimento RR, Mucha JN, Vilella OV. Effects of the cervical headgear in growing Angle Class II malocclusion patients: a prospective study. Dental Press J Orthod. 2020 Mar-Apr;25(2):25-31.

37 Gandini MR, Gandini LG, Martins JC, Del Santo M. Effects of cervical headgear and edgewise appliances on growing patients. Am J Orthod Dentofac Orthop. 2001 May;119(5):531-9.

FIGURAS

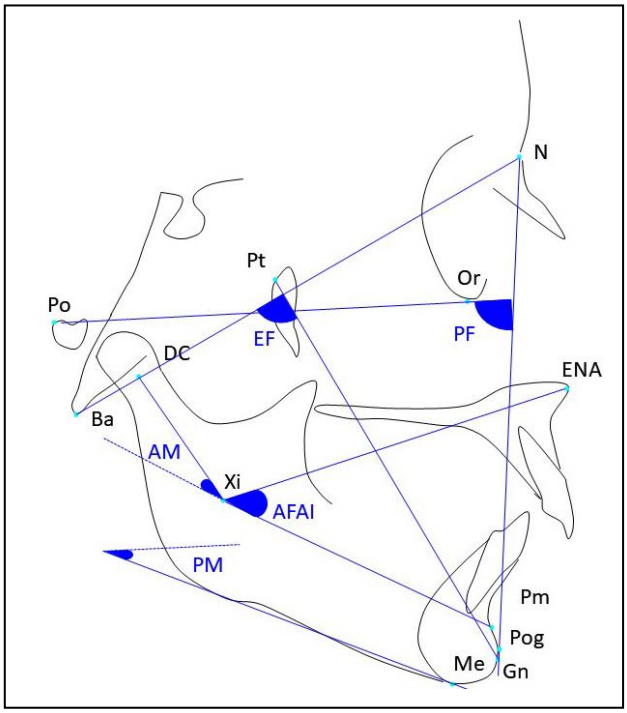


Figura 1. Medidas cefalométricas utilizadas na determinação do VERT de Ricketts[31]: Profundidade Facial (PF), Eixo Facial (EF), Arco Mandibular (AM), Altura Facial Inferior (AFAI) e Plano Mandibular (PM).

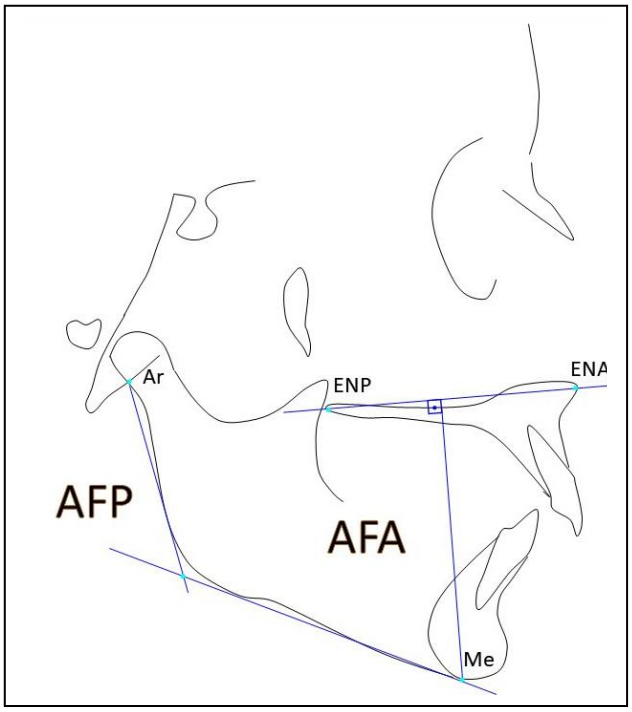


Figura 2. Medidas cefalométricas utilizadas da determinação do IAF: Altura Facial Posterior (AFP) e Altura Facial Anterior (AFA) (análise de HORN, 1992; GEBECK, MERRIFIELD, 1995b).

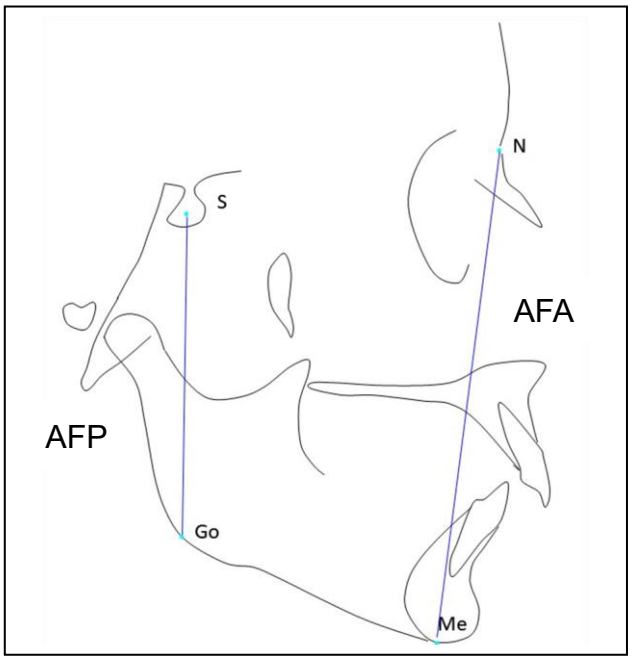


Figura 3. Medidas cefalométricas utilizadas da determinação da PAF: Altura Facial Posterior (AFP) e Altura Facial Anterior (AFA) (análise de SIRIWAT, JARABAK, 1985).

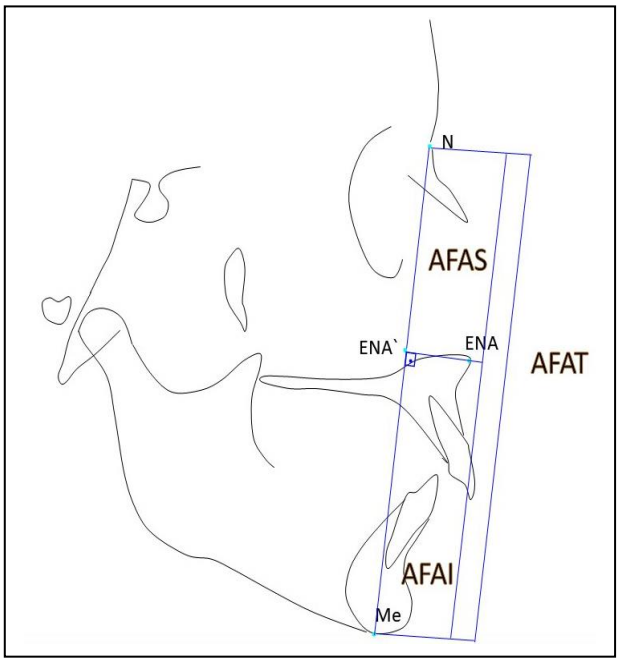


Figura 4. Medidas cefalométricas utilizadas da análise de WYLIE, JOHNSON (1952): Altura Facial Anterior Total (AFAT), Altura Facial Anterior Superior (AFAS) e Altura Facial Anterior Inferior (AFAI).

3.2 Capítulo 2

The effects of modified Thurow appliance on facial pattern of growing hyperdivergent Class II patients: a systematic review of clinical studies

Aline Levi Baratta Monteiro[1]; Ana Carolina de Figueiredo Costa[2], Pedro César Fernandes dos Santos[3], José Jeová Siebra Moreira Neto[4].

[1] DDS, PhD Student, Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil. alinebaratta@yahoo.com.br.

[2] DDS, PhD Student, Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil. carolinafigueired@gmail.com.

[3] DDS, PhD, Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil. pecefesa@gmail.com.

[4] DDS, PhD, Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil. jeova@ufc.br.

Corresponding author: Aline Levi Baratta Monteiro. Department of Clinical Dentistry, Faculty of Pharmacy, Dentistry and Nursing, Federal University of Ceará - Monsenhor Furtado Street, no number, Rodolfo Teófilo, ZIPCODE: 60430-350, Fortaleza, Ceará, Brazil. Phone/Fax: + 55 (85) 3366 8232. E-mail: alinebaratta@yahoo.com.br.

Title: The effects of modified Thurow appliance on facial pattern of growing hyperdivergent Class II patients: a systematic review of clinical studies

Abstract

Background: One of the appliances used in the treatment of Class II growing individuals is the modified Thurow appliance (MTA). In cases where, in addition to an inadequate anteroposterior relationship, a hyperdivergent growth pattern is observed, it is also necessary to control the vertical growth of the maxilla during treatment. This work consisted of a systematic review carried out to investigate the effects of MTA on the facial pattern of growing hyperdivergent Class II patients. Other effects were also evaluated, such as: correction of the open bite, reduction of the overjet, verticalization of incisors and alterations in the sagittal relationships between molars and/or between bone bases.

Methods: After registration (CRD42021271930), an unrestricted electronic database search in PubMed (MEDLINE), Science Direct, Scopus, Embase, Cochrane Library, LILACS, Google Scholar and ProQuest were performed up to August 2021. Retrospective and prospective clinical studies that evaluated the dentoskeletal changes in hyperdivergent Class II subjects who used the MTA were included. Subsequently, data were extracted from general information from the studies, specific information on orthodontic treatment and main outcomes and conclusions. The risk of bias assessment was performed with the Cochrane Collaboration's tool.

Results: The investigation results revealed that the use of MTA provides: (1) inhibition of the vertical development of the maxilla, especially in the posterior region, with counterclockwise rotation of the mandible; (2) facial pattern maintenance; (3) a significant overjet reduction; (4) improvement in the interincisal relationship; (5) establishment of a Class I posterior occlusion.

Conclusions: In general, MTA maintains the facial pattern or does not increase facial divergence during Class II treatment in hyperdivergent patients. However, additional clinical trials of better quality are needed to elucidate the real effects of this therapy on the growth pattern of these patients.

Keywords: Malocclusion, Angle Class II; Prognathism; Extraoral Traction Appliances; Vertical Dimension.

1. Introduction

Class II malocclusion is defined by a distal relationship of the mandible to the maxilla, which may be skeletal origin, with maxillary protrusion and/or mandibular retrusion [1], or dental, when the lower teeth are positioned distally to the upper teeth [2].

The treatment can be performed in different ways, depending on the patient's age, the nature of the disharmony [3], the facial pattern [4], as well as the jaw(s) involved (maxilla and/or mandible) [5, 6].

Normally, individuals who have maxillary bone protrusion and are still growing are treated with extraoral appliances to eliminate or reduce the sagittal discrepancy [5, 7, 8]. In cases where, in addition to inadequate anteroposterior relationship, a hyperdivergent growth pattern is observed, with increased anterior facial height (AFH), lack of passive lip seal and increased mandibular plane angle, with clockwise rotation of the mandible, the control of the vertical growth of the maxilla is also necessary during treatment [4, 9]. In contrary, the facial pattern may, instead of improving, be impaired or not changed [10, 11].

In 1975, Thurow published an extraoral appliance combined to acrylic plate with occlusal coverage of all erupted upper teeth, which was then called “maxillary splint”. Its objective was to restrict the growth of the maxilla, while allowing the mandible to rotate counterclockwise. In addition, the acrylic cover disoccluded the teeth, eliminating possible occlusal interferences during the application of force (F), which facilitated the distalization of the upper teeth and the correction of functional mandibular dislocations [12].

Since then, considering the importance of controlling the vertical growth of the maxilla in the treatment of sagittal discrepancies [4], other researchers made modifications to the original design, resulting in what might be called the modified Thurow appliance (MTA) [13, 14, 15]. This alternative treatment has been widely accepted and used in the correction of skeletal Class II in growing individuals, because, despite the different designs, it is capable of acting in the restriction of maxillary development, both horizontally and vertically [16, 17, 18, 19].

The facial and dentoskeletal effects of using this device have already been investigated, showing: improvement in facial appearance [20, 21]; correction of open bite (OB), in cases where it is present [15, 17]; reduction of overjet and vulnerability of the upper incisors to the occurrence of fractures, due to the uprighting of these teeth [22]; changes in the sagittal relationships between the molars [4, 18, 23]. Furthermore, some studies show that this therapeutic modality alters cephalometric measurements related to the facial pattern [24, 25].

This topic is of great interest due to its clinical relevance, because, especially in hyperdivergent patients, this change can contribute to the success of the treatment or, at least, not harm to its end. However, there is still no systematic review (SR) to elucidate the true effects of this therapy on facial pattern.

Therefore, the present study aimed to perform a SR of the effects of MTA on facial pattern of growing hyperdivergent Class II individuals.

2. Methods

This SR was registered in the PROSPERO database (CRD42021271930). It was performed in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement and following the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions.

2.1. Focused question

The focused question serving for literature search was structured according to the PICO (Patients, Intervention, Control, Outcome) strategy: "Does the use of the modified Thurow appliance in hyperdivergent Class II patients change the facial pattern?" According to the PICO convention, this question has been formulated as follows:

- Population (P): Class II hyperdivergent patients, of both sexes, who are growing, with mixed or permanent dentition, without restriction on ethnic or socioeconomic group, in whom restriction of maxillary growth is indicated.
- Intervention (I): use of the MTA.
- Control (C): patients who were not treated or used another appliance for the treatment of Class II.
- Outcome (O): The outcomes could include the changes in facial pattern, open bite correction, reduction of overjet, upper incisor uprighting, and changes in sagittal relationships between molars and/or between bone bases.

2.2 Search Strategy

The main search was performed of the following electronic databases through

August 2021: PubMed (MEDLINE), Science Direct, Scopus, Embase, Cochrane Library, LILACS. A combination of the Boolean operators AND/ OR and the following MeSH/ non-MeSH terms were used to identify pertinent studies: “Malocclusion, Angle Class II”, “Maxillary Prognathism”, “Extraoral Traction Appliances”, “Thurow appliance”. Unpublished literature was searched on Google Scholar and ProQuest. The reference lists of all eligible studies were hand-searched to identify any additional relevant articles (Supplementary File 1).

2.3 Study selection

Two independent reviewers (ALBM and ACFC) performed the study selection that comprised of title-reading, abstract-reading, and full-text-reading stages. After exclusion of duplicate and non-eligible studies, the full reports considered by either author, eligible for inclusion, were assessed independently. Cases of disagreements were resolved by a third reviewer (PCFS).

2.4 Eligibility criteria

Retrospective and prospective clinical studies involving Class II hyperdivergent patients, of both sexes, of whom restriction of the maxillary growth is indicated. The change in facial pattern, open bite correction, reduction of overjet, upper incisor uprighting and changes in sagittal relationships between molars and/or between bone bases were considered the outcomes for this SR. There was no restriction on publication date or language. Case reports, opinion, review articles and non-clinical studies were excluded.

2.5 Data extraction

The relevant data and the quality from the included studies were extracted and recorded independently by each of the two review authors (ALBM and ACFC). A third reviewer (PCFS) resolved any discrepancies.

Information from the included studies was synthesized by tabulating the general information of the studies, including author, year of publication, research location, study design, number of participants along with their age and gender, treatment time and follow-up. The specific information included the evaluation method and the MTA characteristics [design, direction of traction, amount of hours/day of use and magnitude of F (g)]. At the end, the main

outcomes (dental skeletal changes) and conclusions of the articles included were also synthesized.

2.6 Risk of bias assessment

Two independent authors (ALBM and ACFC) performed the risk of bias by the Cochrane Collaboration's tool [26]. A third reviewer (PCFS) resolved any disagreements through discussions. This tool contains seven items: (1) random sequence generation—selection bias, (2) allocation concealment—selection bias, (3) blinding of participants and personnel—performance bias, (4) blinding of outcome assessment—detection bias, (5) incomplete outcome data—attrition bias, (6) selective reporting—reporting bias, and (7) other bias. The bias of each study was rated as low, high or uncertain, after a careful review by the reviewers.

3. Results

3.1 Study selection

A total of 1536 articles were identified in the initial search. Duplicate references (n=245) were manually removed and 1291 remained. Based on the PICO strategy defined in this SR, 1253 irrelevant studies were excluded by reading titles and abstracts. The eligibility criteria were applied to the full text of 38 studies. At the end, seven studies were included for data extraction and qualitative synthesis (Fig. 1; Supplementary File 2).

3.2 General information of the included studies

The seven eligible studies were longitudinal and experimental, four prospective [4, 27, 28, 29] and three retrospective [25, 30, 31], published from 1984 to 2014. In three of them, in addition to the treated group, there was also a control group [4, 27, 29]. Four studies were developed in Brazil [25, 29, 30, 31], one in Switzerland [28] and two in Denmark [4, 27]. A total of 136 patients, aged between 4 and 10, were evaluated. In all researches, hyperdivergent Class II Division I patients, who needed maxillary growth restriction, were treated with MTA, and the treatment time ranged from 0.6 to 1.2 years. In one of them, there was also a follow-up after the end of the treatment (eight months or more) [27] (Table 1).

3.3 Specific information of the included studies

The evaluation method used in the seven studies was the cephalometric analysis, at the beginning and at the end of the treatment, although different linear and angular quantities were adopted.

In five studies, the connection of the headgear (HG) to the acrylic plate was made through a telescopic tube inserted into the acrylic [4, 25, 27, 31] or welded to the plate retainers [28], thus allowing insertion and removal of the device. In the other studies [29, 30], the HG was fixed to the acrylic plate following the palate and/or upper teeth.

In some researches, an expansion screw was inserted into the center of the acrylic plate at the level of the deciduous second molars [25, 29] or between the deciduous molars and maxillary first molars [31]. In the other research, it was only inserted when there was a crossbite [28]. Meanwhile, although Paulin has adopted the MTA described by Pinto et al., which contains the expansion screw [15], he did not use it in order to standardize his study, despite recognizing that it is useful due to the need for maxillary transversal adjustment, resulting from the patients' growth [30]. When the anterior OB was present, five studies attached a palatal grid to the acrylic plate [4, 27, 28, 29, 30]. In addition, in four studies, a Hawley buccal arch was inserted into the acrylic, both to aid retention of the MTA [30] and to lingualize the upper incisors, when necessary [25, 29, 31].

Regarding the number of hours needed/day to use the device, three studies recommended 14 hours/day [25, 28, 29], one study recommended 16 hours/day [31], two studies recommended 10 to 18 hours/day [4, 27] and one study recommended full-time use (only removing it for sports and food) [30]. High pull, used in all treatments, allowed the F, which ranged from 250-900g/side, to be directed over the center of resistance of the maxilla (CRM) [25, 30, 31] or posteriorly to it [4, 27, 28, 29] (Table 2).

3.4 Main outcomes and conclusions of the included studies

The dental changes found in the sagittal plane were reduction in the overjet [4, 30]; improvement in the molar [4, 27, 28, 30], canine [28] and interincisal [4, 27, 30] relationship and incisor uprighting [30]. In the vertical plane, the non-eruption of the upper molars in relation to the palatal plane was reported in one study [27].

Most research showed that MTA improves the sagittal relationships between maxilla and mandible [4, 28, 29, 30, 31]. However, some assigned this result to the restriction

of the maxillary growth [28, 29], in other researches, to the mandible growth/counterclockwise rotation [30, 31] and in others, to both [4]. However, another study [27] found that the relapse occurred immediately after the discontinuation of forces that restricted the sagittal and vertical development of the maxilla, although the skeletal relapse is not always followed by dental relapse.

Correction of the anterior OB was reported by four studies [28, 29, 30, 31], although all recorded changes in the PP (palatal plane) and/or the OP (occlusal plane) in favor of this correction, that is, clockwise rotation. De Baets et al. found a reduction of the Spa-Spp / MGo angle by 3.19° ($p < 0.01$), as well as a clockwise inclination of the PP in relation to the SN line, by 2.56° ($p < 0.01$). Garbui et al. found an increase in the SN.PP angle, although, clinically speaking, this increase was considered small.

Regarding the effects of MTA on facial pattern, increases in AFH and posterior facial height (PFH) were noted in three studies [25, 30, 31]. However, in one of them [25], it was emphasized that the increases occurred proportionally to each other, indicating that there was no increase in facial divergence. Likewise, the authors of another research [4] found that the relationship between AFH and PFH did not change significantly. In contrast, a study [29] pointed to a reduction in lower facial height (LFH) in the experimental group and an increase in the control group.

Although Garbui et al. and De Baets et al. did not find a significant change in the craniomandibular plane angle (SN/MP) (mean decrease of 0.81°), most studies, included in this SR, reported a decrease in the angle of the mandibular plane (MP) [29, 30, 31] or other measures related to the facial pattern, such as the Y axis and FMA [25, 31]. Despite this, the maintenance of the facial pattern and no increase in the facial divergence were clinically observed, which makes MTA an effective treatment option for Class II hyperdivergent patients (Table 3).

3.5 Risk of bias assessment

All included studies [4, 25, 27, 28, 29, 30, 31] presented a high risk of bias for the random sequence generation, allocation concealment, blinding of participants and personnel and blinding of the outcome assessment domains. On the other hand, almost all studies included [4, 25, 27, 29, 30, 31] presented a low risk of bias for the incomplete outcome data, selective reporting and other bias domains. The only exception was the study by De Baets et al., which presented a high risk of bias in the incomplete outcome data item (Fig. 2).

4. Discussion

Generally, the most difficult orthodontic problems are associated with patients with hyperdivergent facial phenotypes [9, 32]. In such situations, the need for vertical control is essential to maintain or improve the facial pattern [4]. The current SR brought together studies that addressed the treatment of Class II individuals in the growth phase, being similar to previous SR [33, 34]. However, as far as we know, this is the first SR to consider only subjects with a hyperdivergent facial pattern, thus giving due importance to such a relevant characteristic.

In only one of the articles in the present SR [27], patients continued to be followed up after MTA removal and recurrence was observed immediately after interruption of F that restricted the sagittal and maxillary vertical. When searching for other studies in the literature, in which patients treated with MTA were evaluated in the long term, a huge lack was noticed. Therefore, it is necessary to carry out further studies to clarify the stability of early Class II correction, using MTA, including to determine whether the therapy needs to be maintained or not, until the end of the growth period.

Although different quantities are used to evaluate the same parameter, cephalometric analyses has been widely used in the literature [3, 7, 8, 19, 23, 24], in the same way as all studies in this SR.

In general, the alternatives for the treatment of skeletal Class II in growing patients are vast in the literature [5, 6, 8, 18, 35]. However, in hyperdivergent patients, the possibilities are more restricted, and vertical control during treatment is of paramount importance [4, 10, 24]. On the other hand, it is noteworthy that Gkantidis et al. compared hyperdivergent Class II Division 1 patients treated with and without vertical control measures in order to investigate whether this would affect the vertical dimension at the end of treatment. They concluded that the most important factors in the development and establishment of the vertical skeletal pattern were the neuromuscular and functional balance as well as demonstrating the limitations of conventional orthodontics to significantly alter vertical skeletal dimensions [36]. Another aspect related to the importance of controlling the vertical growth during the treatment of Class II in hyperdivergent patients is based on the fact that the sagittal development of the mandible is partially dependent on the vertical development of the maxilla [4, 24, 32]. In other words, the maxillomandibular discrepancy could be improved by the vertical control in the maxillary molar region and consequent rotation of the mandible in a counterclockwise direction.

Based on this premise, different approaches have been suggested in the literature, such as: HG with high or combined traction applied directly to the bands fixed on the maxillary

first molars [37, 38]; HG connected to acrylic plates fitted to the palate and/or upper teeth [12, 13, 14, 15]; and activators connected or not to the HG [39]. In cases of retrognathic individuals, Buschang et al. still proposed rapid maxillary expansion followed by the use of miniscrews in the posterior regions, in order to intrude these segments and allow Class II correction by the mandibular growth itself [32]. Despite being more advantageous as it does not require the patient's cooperation, this treatment option was suggested in individuals with permanent dentition, that is, at an age a little older than the one in which the MTA, objective of analysis of this SR, has been indicated.

To determine the direction of traction, as well as the inclination and size of the external arch of the HG, one must take into account the treatment objective and the patient's facial pattern. Depending on these factors, different F vectors can lead to different types of skeletal changes [40]. When traction is cervical, there may be extrusion and/or tipping of the maxillary molars, with clockwise rotation of the mandible [11], opening of the mandibular plane angle, and increase in AFH [40]. On the other hand, high pull HG produces an intrusive component [12, 13, 16], being beneficial in cases of hyperdivergent patients, in whom restriction of vertical development is desired. In line with these findings, all studies of the present SR used this direction of pull. On the other hand, two studies were against this fact. Sambataro et al. used cervical HG in 20 Class II patients with increased vertical dimension and compared them to an untreated control group, finding a reduction in the vertical dimensions in the treated group, in addition to a change from a Class II vertical growth pattern to a normal growth pattern [41]. Pithon et al. despite using MTA with cervical traction in 45 patients, they did not observe a significant clockwise rotation of the mandible [19]. Still with the aim of directing the F application point as close as possible to the CRM [4, 42], the external arches should be bent, preferably 45° above the occlusal plane [8, 12, 24] and finished at the level of the maxillary first permanent molars [3, 12, 24]. In contrast, other researchers have adopted a long arch in order to prevent extrusion of the maxillary molars when using cervical traction [19].

A great part of the literature has suggested the use of MTA for 12 to 18 hours/day [7, 8, 15, 18, 19, 20] corroborating with almost all the articles of this SR [4, 25, 27, 28, 29, 31]. Only an article [30] suggested full-time use (day and night), with the exception of sports and meal times, similarly to what was recommended in previous studies [3, 23, 24] and in the study by Joffe and Jacobson, in which it was instructed to use it for 20 to 22 hours/day [13].

The magnitude of the F required to obtain an orthopedic effect has been studied by some authors [42, 43]. Firouz et al. evaluated the dental and skeletal effects of HG with high

traction in 20 Class II patients, in relation to a control group, and concluded that the F of 500g was sufficient to promote orthopedic changes in the maxilla, even if all maxillary teeth were not fully bonded [16]. This goes against what had been postulated by Thurow, in 1975, since he would have suggested the application of 300g, on average, and the union of all teeth by means of an acrylic plate, in order to obtain better results [12]. With the exception of the study by De Baets et al., in which heavier forces (900g/side) were used in order to obtain an orthopedic effect more quickly [28], all other studies of the present SR used the magnitude of 300 at 500g of F, in accordance with part of the literature [8, 15, 18, 19, 20, 24] and in contrast elsewhere [3, 7, 13, 23].

One of the benefits of early Class II treatment is a decreased risk of dental trauma in the following years [22, 34], due to reduced overjet, incisor uprighting and improvement in maxillomandibular sagittal discrepancy. Except in the study of Garbui et al., which only analyzed vertical measures [25], these findings were commonly observed in the studies included in this SR, corroborating other publications [3, 5, 6, 7, 18, 19, 23, 24]. Miguel et al. compared the dentoskeletal effects of MTA (MSG group) and cervical HG (CHG group), and found that in MSG, the overjet showed a significantly greater decrease (-2.4mm) than in CHG (-0.7mm), as well as incisor verticalization (− 1.8 mm in MSG and 0.4 mm in CHG) [8]. Improvement of the sagittal discrepancy is usually achieved by a combination of dentoalveolar and skeletal changes. After comparing samples treated with MTA and Bionator, Almeida-Pedrin et al. and Martins et al. stated that MTA effectively corrected Class II malocclusion primarily because of the dentoalveolar changes, but also because of minor but significant skeletal effects [5, 18]. Decreased ANB, SNA, and increased SNB (or other cephalometric measurements representative of bone bases), frequently found in the literature [3, 5, 6, 7, 8, 18, 19, 23, 24], demonstrate the contribution of the skeletal component in this process.

In the vertical direction, all articles in the present SR registered changes in the PP and/or OP clockwise, in the same way as other articles in the literature [3, 5, 8, 23]. Such a modification seems to be reflected on the closing of the OB [15, 17]. However, one cannot fail to consider that some authors have included a palatal grid in their appliances when this malocclusion was present [4, 27, 28, 29, 30], according to what was suggested by Pinto et al. [15]. Therefore, the effectiveness of the MTA in correcting the OB may have been enhanced by this feature.

In order to evaluate the effects of MTA on the facial pattern, the analysis of some cephalometric measures such as: AFH, PFH, MP angle, Y axis and FMA; are commonly used in the literature. Some studies of this SR [25, 30, 31] noted an increase in AFH and PFH,

similarly to the study by Silvestrini-Biavati et al. who reported an increase in AFH in relation to the control group (4.6mm and 2.8mm, respectively), as well as in the PFH (3.6mm and 1.67mm, respectively) [7]. However, it was found that such changes did not imply an increase in facial divergence, because both increased proportionally to each other (AFH/PFH=0.6mm treated group and 0.3mm control group; $p = 0.59$). Meanwhile, Jacob et al. found a reduction in LFH in the experimental group and an increase in the control group [29]. Regarding changes in the MP angle, Y axis and FMA, most studies of this SR followed much of the literature that points to a decrease in these cephalometric measurements [5, 6, 7, 18], however, in most cases, not significantly. In contrast, other surveys have observed increases in these measures. Caldwell et al. reported an increase in the SN/MP and FMA angles (0.39º and 0.34º respectively), when treating 47 patients using MTA, but without significance either [23]. On the other hand, Seçkin and Surucu stated that these angles were increased by 0.86º and 1.1º ($p < 0.001$) respectively, portraying a small increase in the vertical dimension [3]. This maintenance of the pattern seems to be related to the control of the vertical growth of the posterior region of the maxilla, which allows a counterclockwise rotation of the mandible [12], although Üner and Yücel-Eroqlu found that the vertical control should exist in the posterior region, but in the anterior region, it should be even more restricted or reversed [24].

In carrying out the present SR, we did not find recent articles dealing with the subject, nor any randomized clinical trial (RCT), although Papageorgiou et al. did not find a difference between RCT and non-RCT, when investigating whether or not randomization and the time of data collection (retrospective or prospective), in orthodontic research, influenced the results of clinical trials [44]. Other limitations of the present study were the reduced number of articles involving hyperdivergent patients; the retrospective nature of three articles included [25, 30, 31]; the lack of studies with long-term results and the absence of a control group in most studies [25, 28, 30, 31]. Therefore, it is necessary to develop more recent studies with better designs, involving patients with vertical growth, so that new SR can be developed rigorously and with more informed conclusions.

5. Conclusions

In general, MTA maintains the facial pattern or does not increase facial divergence during Class II treatment in hyperdivergent patients. However, due to the limitations of the present study, additional clinical trials of better quality are needed to elucidate the real effects of this therapy on the growth pattern of these patients.

Figure Legend

Supplementary File 1. Search Strategy.

Figure 1. Representative flowchart of the identification and selection of studies included in the systematic review.

Supplementary File 2. Reasons for exclusion in the full-text reading step.

Table 1. General information of the included studies.

Table 2. Specific information of the included studies.

Table 3. Main outcomes and conclusions of the included studies.

Figure. 2 Summary of the risk of bias by Cochrane Collaboration's tool of included studies. The colors indicate the following: low risk of bias (green/-) and high risk of bias (red/+).

List of abbreviations

AFH: anterior facial height. F: force. MTA: modified Thurow appliance. OB: open bite. SR: systematic review. PRISMA: Preferred Reporting Items for Systematic reviews and Meta-Analyses. PICO: Patients, Intervention, Control, Outcome. HG: headgear. CRM: center of resistance of the maxilla. PP: palatal plane. OP: occlusal plane. PFH: posterior facial height. LFH: lower facial height. MP: mandibular plane. RCT: randomized clinical trial.

Acknowledgments

Not applicable

Authors' contributions

ALBM: performed the concept and design of the study, search strategy, data extraction and qualitative synthesis, and wrote the manuscript. ACFC: performed the concept and design of the study, search strategy, data extraction and qualitative synthesis, and wrote the manuscript. PCFS and JJSMN: guided the study and critically reviewed the manuscript. The author(s) read and approved the final manuscript.

Funding

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1] Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil.

[2] Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil.

[3] Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil.

[4] Department of Clinical Dentistry, Federal University of Ceará, Fortaleza, Ceará, Brazil.

References

1 McNamara JA. Components of Class II Malocclusion in Children 8-10 Years of Age. Angle Orthod. 1981;51:177-202.

2 Angle EH. Classification of malocclusion. Dent Cosmos. 1899;41:350-75.

3 Seçkin Ö, Surucu R. Treatment of Class 11, division 1, cases with a maxillary traction splint. Quintessence Int. 1990;21:209-15.

4 Fotis V, Melsen B, Williams S, Droschl H. Vertical control as an important ingredient in the treatment of severe sagittal discrepancies. Am J Orthod. 1984;86:224-32. https://doi.org/10.1016/0002-9416(84)90374-9.

5 Almeida-Pedrin RR, Almeida MR, Almeida RR, Pinzan A, Ferreira FP. Treatment effects of headgear biteplane and bionator appliances. Am J Orthod Dentofac Orthop. 2007;132:191-98. https://doi.org/10.1016/j.ajodo.2005.07.030.

6 Fernandes AF, Brunharo IH, Quintão CC, Costa MG, Oliveira-Costa MR. Effectiveness of twin blocks and extraoral maxillary splint (Thurow) appliances for the correction of Class II relationships. World J Orthod. 2010;11:230-35.

7 Silvestrini-Biavati S, Lazzarotti L, Bini S, Migliorati M, Ugolini A. Maxillary "en masse" high-pull traction in Class II division 1 subjects: which kind of skeletal outcomes does it

produce? Eur J Paediatr Dent. 2020; 21:271-76. https://doi.org/10.23804/ejpd.2020.21.04.3.

8 Miguel JA, Masucci C, Fernandes LQ, Artese F, Franchi L, Giuntini V. Dentoskeletal effects of the maxillary splint headgear in the early correction of Class II malocclusion. Prog Orthod. 2020; https://doi.org/10.1186/s40510-020-00311-x.

9 Del Santo M, Jacob H, Bósio JA. O desafio do tratamento ortodôntico do paciente com fenótipo facial hiperdivergente. Rev Assoc Paul Cir Dent. 2016;70:204-9.

10 Creekmore TD. Inhibition or stimulation of the vertical growth of the facial complex, its significance to treatment. Angle Orthod. 1967;37:285-97. https://doi.org/10.1043/0003-3219(1967)037<0285:IOSOTV>2.0.CO;2.

11 Melsen B. Effects of cervical anchorage during and after treatment: An implant study. Am J Orthod. 1978;73:526-40. https://doi.org/10.1016/0002-9416(78)90242-7.

12 Thurow RC. Craniomaxillary orthopedic correction with en masse dental control. Am J Orthod. 1975;68:601-24. https://doi.org/10.1016/0002-9416(75)90096-2.

13 Joffe L, Jacobson A. The maxillary orthopedic splint. Am J Orthod. 1979;75:54-69. https://doi.org/10.1016/0002-9416(79)90139-8.

14 Henriques JF, Martins DR, Almeida GA, Ursi WJ. Modified maxillary splint for Class II, Division 1 treatment. J Clin Orthod. 1991;25:239-45.

15 Santos-Pinto A, Martins LP, Melo AC, Paulin RF, Oshiro L. O aparelho extra-bucal de Thurow modificado no tratamento da Classe II com mordida aberta - caso clínico. Rev Dent Press Ortod Ortop Facial. 2001;6:57-62.

16 Firouz M, Zernik J, Nanda R. Dental and orthopedic effects of high-pull headgear in treatment of Class II, in Division 1 malocclusion. Am J Orthod Dentofac Orthop. 1992;102:197-205. https://doi.org/10.1016/s0889-5406(05)81053-4.

17 Stuani MB, Stuani AS, Stuani AS. Modified Thurow appliance: a clinical alternative for correcting skeletal open bite. Am J Orthod Dentofac Orthop. 2005;128:118-25. https://doi.org/10.1016/j.ajodo.2005.02.014.

18 Martins RP, Martins JC, Martins LP, Buschang PH. Skeletal and dental components of Class II correction with the bionator and removable headgear splint appliances. Am J Orthod Dentofac Orthop. 2008;134:732-41. https://doi.org/10.1016/j.ajodo.2007.07.022.

19 Pithon MM, Santos RL, Sampaio GA, Meneses IH, Coqueiro RS. Anteroposterior and vertical changes in skeletal Class II patients treated with modified Thurow appliance. Braz Dent J. 2014;25:170-4. https://doi.org/10.1590/0103-6440201302389.

20 Orton HS, Slattery DA, Orton S. The treatment of severe 'gummy' Class II division 1 malocclusion using the maxillary intrusion splint. Eur J Orthod. 1992;14:216-23. https://doi.org/10.1093/ejo/14.3.216.

21 Pithon MM, Lacerda-Santos R, Oliveira DL, Alves JV, Britto JP, Sousa ES, et al. Esthetic perception of facial profile after treatment with the Thurow appliance. Braz Oral Res. 2015; doi:10.1590/1807-3107BOR-2015.vol29.0043.

22 Batista KB, Thiruvenkatachari B, Harrison JE, O'Brien KD. Orthodontic treatment for prominent upper front teeth (Class II malocclusion) in children and adolescents. Cochrane Database Syst Rev. 2018; doi:10.1002/14651858.CD003452.pub4.

23 Caldwell SF, Hymas A, Timm TA. Maxillary traction splint: a cephalometric evaluation. Am J Orthod. 1984;85:376-84. https://doi.org/10.1016/0002-9416(84)90158-1.

24 Üner O, Yücel-Eroglu E. Effects of a modified maxillary orthopaedic splint: a cephalometric evaluation. Eur J Orthod. 1996;18:269-86. https://doi.org/10.1093/ejo/18.3.269.

25 Garbui IU, Nouer PR, Nouer DF, Magnani MB, Neto JS. Cephalometric assessment of vertical control in the treatment of class II malocclusion with a combined maxillary splint. Braz Oral Res. 2010;24:34-9. https://doi.org/10.1590/s1806-83242010000100006.

26 Higgins JP, Altman DG, Gotzsche PC, Cochrane Bias Methods Group, Cochrane Statistical Methods Group, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomized trials. BMJ. 2011;343:d5928. https://doi.org/10.1136/bmj.d5928.

27 Fotis V, Melsen B, Williams S. Posttreatment changes of skeletal morphology following treatment aimed at restriction of maxillary growth. Am J Orthod. 1985;88:288-96. https://doi.org/10.1016/0002-9416(85)90127-7.

28 De Baets J, Schatz JP, Joho JP. Skeletal changes associated with plate-headgear therapy in the early mixed dentition. J Clin Orthod. 1995;29:700-5.

29 Jacob HB, Pinto AS, Buschang PH. Dental and skeletal components of Class II open bite treatment with a modified Thurow appliance. Dental Press J Orthod. 2014;19:19-25. https://doi.org/10.1590/2176-9451.19.1.019-025.oar.

30 Paulin RF. Alterações dentárias e esqueléticas no tratamento da má oclusão de Classe II divisão 1 com aparelho extrabucal de Thurow modificado. [doctoral thesis]. Araraquara. Universidade Estadual Paulista; 2008.

31 Mazali M, Garbui IU, Nouer DF, Nouer PR. Controle vertical no tratamento da maloclusão classe II, divisão 1 de Angle associada à mordida aberta com aparelho extrabucal conjugado. Rev Gaúch Odontol. 2011;59:15-21.

32 Buschang PH, Carrillo R, Rossouw PE. Orthopedic correction of growing hyperdivergent, retrognathic patients with miniscrew implants. J Oral Maxillofac Surg. 2011;69:754-62. https://doi.org/10.1016/j.joms.2010.11.013.

33 Jacob HB, Buschang PH, Pinto AS. Class II malocclusion treatment using high-pull headgear with a splint: a systematic review. Dental Press J Orthod. 2013;18:21.e1-7. https://doi.org/10.1590/s2176-94512013000200009.

34 Papageorgiou SN, Kutschera E, Memmert S, Gölz L, Jäger A, Bourauel C, et al. Effectiveness of early orthopaedic treatment with headgear: a systematic review and meta-analysis. Eur J Orthod. 2017;39:176-87. https://doi.org/10.1093/ejo/cjw041.

35 Ghafari J, Shofer FS, Jacobsson-Hunt U, Markowitz DL, Laster LL. Headgear versus function regulator in the early treatment of Class II, Division 1 malocclusion: a randomized clinical trial. Am J Orthod Dentofac Orthop. 1998;113:51-61. https://doi.org/10.1016/s0889-5406(98)70276-8.

36 Gkantidis N, Halazonetis DJ, Alexandropoulos E, Haralabakis NB. Treatment estrategies for patients with hyperdivergent Class II Division 1 malocclusion: is vertical dimension affected? Am J Orthod Dentofac Orthop. 2011;140:346-55. https://doi.org/10.1016/j.ajodo.2011.05.015.

37 Tortop T, Yüksel S. Treatment and posttreatment changes with combined headgear therapy. Angle Orthod. 2007;77:857-63. https://doi.org/10.2319/042806-179.

38 Zervas ED, Galang-Boquiren MT, Obrez A, Viana MG, Oppermann N, Sanchez F, et al. Change in the vertical dimension of Class II Division 1 patients after use of cervical or high-pull headgear. Am J Orthod Dentofac Orthop. 2016;150:771-81. https://doi.org/10.1016/j.ajodo.2016.04.024.

39 Üçüncü N, Türk T, Carels C. Comparison of modified Teuscher and Van Beek functional appliance therapies in high-angle cases. J Orofac Orthop. 2001;62:224–37. https://doi.org/10.1007/pl00001930.

40 Baumrind S, Korn EL, Molthen R, West EE. Changes in facial dimensions associated with the use of forces to retract the maxilla. Am J Orthod. 1981;80:17-30. https://doi.org/10.1016/0002-9416(81)90193-7.

41 Sambataro S, Fastuca R, Oppermann NJ, Lorusso P, Baccetti T, Franchi L, et al. Cephalometric changes in growing patients with increased vertical dimension treated with cervical headgear. J Orofac Orthop. 2017;78:312-20. https://doi.org/10.1007/s00056-017-0087-z.

42 Teuscher U. An appraisal of growth and reaction to extraoral anchorage. Simulation of orthodontic-orthopedic results. Am J Orthod. 1986;89:113-21. https://doi.org/10.1016/0002-9416(86)90087-4.

43 Talvitie TH, Helminen M, Karsila S, Varho R, Signorelli L, Pirttiniemi P, et al. Impact of force magnitude on effectiveness in cervical headgear therapy: a cephalometric analysis. Eur J Orthod. 2019;41:646-51. https://doi.org/10.1093/ejo/cjz022.

44 Papageorgiou SN, Xavier GM, Cobourne MT. Basic study design influences the results of orthodontic clinical investigations. J Clin Epidemiol. 2015;68:1512-22. https://doi.org/10.1016/j.jclinepi.2015.03.008.

Figuras e tabelas

Supplementary File 1. Search Strategy.

Databases	Terms
Pubmed	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
Science Direct	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
Scopus	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
Embase	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
LILACS	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
Cochrane Library	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
Google Scholar	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)
ProQuest	(“Malocclusion, Angle Class II” OR “Maxillary Prognathism”) AND (“Extraoral Traction Appliances” OR “Thurow appliance”)

Supplementary File 2. Reasons for exclusion in the full-text reading step.

Reasons	Studies
Hyperdivergent pattern is not inclusion criteria.	Araújo, 2010 Almeida-Pedrin, 2007 Caldwell, 1984 Fernandes, 2010 Howard, 1982 Keeling, 1998 Martins, 2008 Miguel, 2020 Nascimento, 2018 Orton, 1992 Pithon, 2014 Pithon, 2015 Seçkin, 1990 Silvestrini-Biavati, 2020 Silvestrini-Biavati, 2019 Thurman, 2011 Üner, 1996 Wheeler, 2002
MTA is not used.	Tulloch, 1997 Aksu, 2017 Baumrind, 1982 Deblock, 1992 Efstratiadis, 2005 Foley, 1997 Ghafari, 1998 Mair, 1992 Mann, 2011 Mew, 2001 You, 2006
It is not a clinical study.	Albanese, 1983 Cassarino, 1985

*MTA: Modified Thurow appliance

Figure 1. Representative flowchart of the identification and selection of studies included in the systematic review.

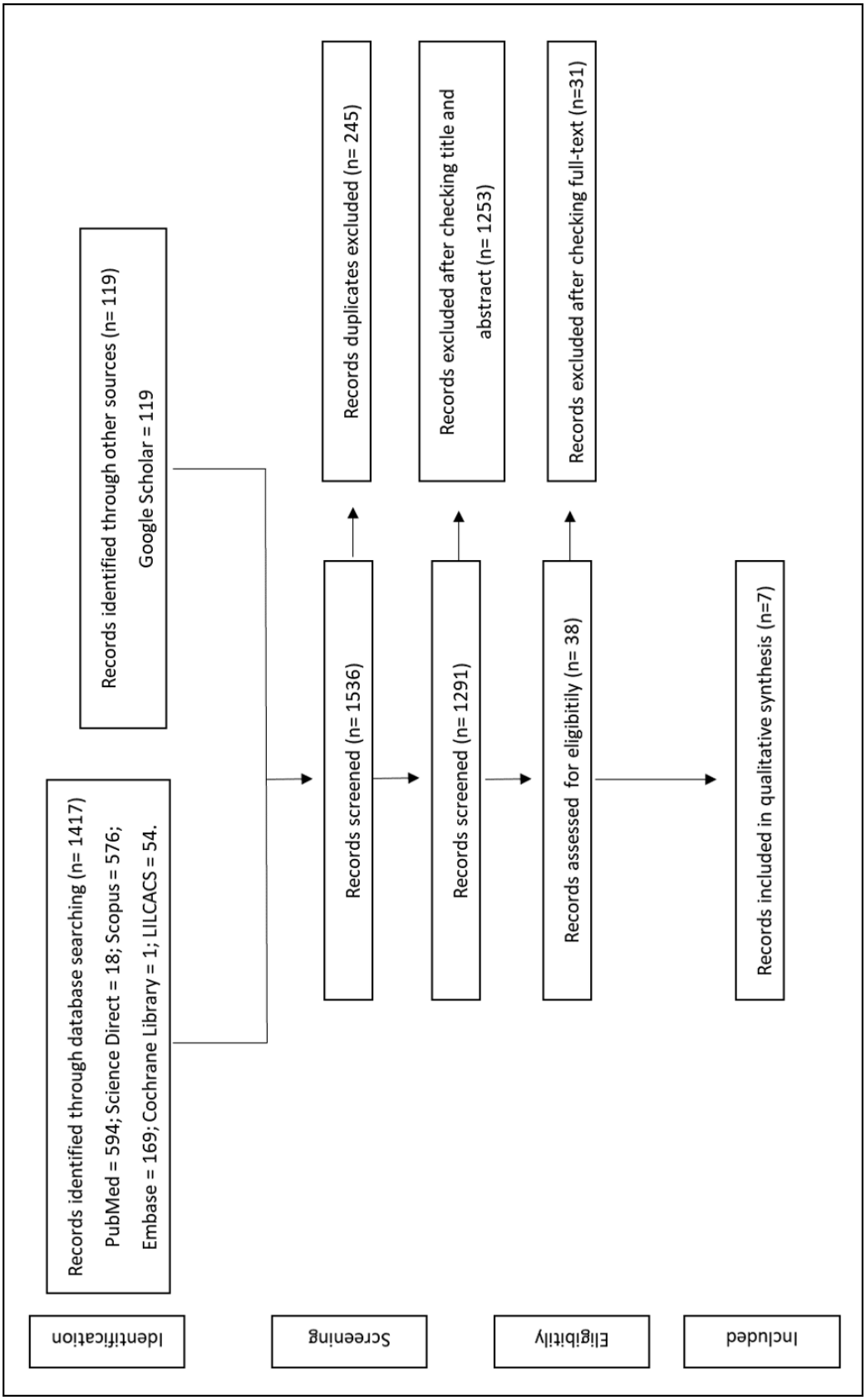
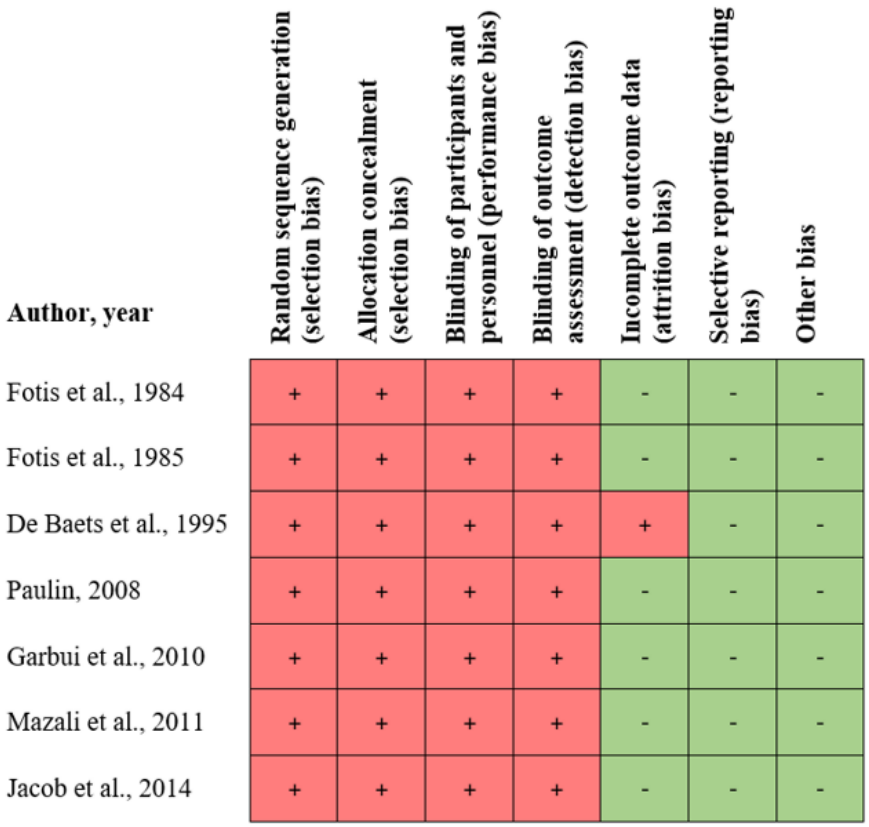


Figure. 2 Summary of the risk of bias by Cochrane Collaboration's tool of included studies. The colors indicate the following: low risk of bias (green/-) and high risk of bias (red/+).



Author, year	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Fotis et al., 1984	+	+	+	+	-	-	-
Fotis et al., 1985	+	+	+	+	-	-	-
De Baets et al., 1995	+	+	+	+	+	-	-
Paulin, 2008	+	+	+	+	-	-	-
Garbui et al., 2010	+	+	+	+	-	-	-
Mazali et al., 2011	+	+	+	+	-	-	-
Jacob et al., 2014	+	+	+	+	-	-	-

Table 1. General information of the included studies.

Author, year	Country	Study design	Sample size (n)	Patients (sex, age)	Treatment time	Follow-up
Fotis et al., 1984	Denmark	phLES	28	16 F/12 M, 9 years	6 a 12 months	Not applicable
Fotis, et al., 1985	Denmark	phLES	28	16 F/12 M, 9 years	8 a 16 months	8 months or more
De Baets et al., 1995	Switzerland	pwLES	20	4 -7.6 years.	0.6 to 1.2 years	Not applicable
Paulin, 2008	Brazil	rwLES	14	12 F/02 M; 07-10 years.	1.1 years	Not applicable
Garbui et al., 2010	Brazil	rwLES	30	15 F/15 M; 9.67 ± 1.75 years.	1.1 years	Not applicable
Mazali et al., 2011	Brazil	rwLES	31	16 F/15 M; 06-09 years.	1.2 years	Not applicable
Jacob et al., 2014	Brazil	phLES	13	12 F/01 M; 07-10 years.	12 months	Not applicable

phLES: longitudinal and experimental study with prospective intervention and historical control group; pwLES: longitudinal and experimental study with prospective intervention and without control group; rwLES: longitudinal and experimental study with retrospective intervention and without control group; F female; M: male.

Table 2. Specific information of the included studies.

		MTA characteristics			
Author, year	**Evaluation method**	**Design**	**Direction of traction**	**Amount of hours/day of use**	**Magnitude da F (g)**
Fotis, 1984	Cephalometric analysis	Maxillary splint with telescopic tubes fixed in the molar region to allow adaptation of the HG, which had the external bow parallel to the OP. When the anterior OB was present, an anterior tongue crib was added to the splint.	High pull with F directed was at the level of the posterior border of the maxilla.	10 to 18 hours/day	400 to 500 g on each side.
Fotis, 1985	Cephalometric analysis				
De Baets, 1995	Cephalometric analysis	Acrylic palatal plate with bilateral bite planes and telescopic tubes placed at the midpoint of the distance from the canine to the most distal molar on each side, to allow adaptation of the HG, which had an external arch of medium length. When the anterior OB or the posterior crossbite were present, an anterior tongue crib and ES were added to the board, respectively.	High pull with F directed posteriorly to the CRM.	At least 14 hours/day	2 pounds (900g) of force per side
Paulin, 2008	Cephalometric analysis	Acrylic plate with molar coverage and attached HG, with the palate region consisting of an acrylic bridge away from it, to direct the action of force exclusively on the occlusal teeth. It also contained: ES, buccal arch and palatal grid.	Upward and backward pull direction, which causes the generated force to be directed over the CRM.	Full-time (day and night), being removed only for sports and during meals.	400g per side
Garbui, 2010	Cephalometric analysis	Acrylic resin plate covering the palate, occlusal surface of the posterior teeth and lingual surface of the anterior teeth; with a telescopic tube in the palatal region, allowing the insertion and removal of the HG. It also contained: an ES placed between premolars or deciduous second molars and a Hawley-type buccal arch fixed to the plate.	High pull with F directed as near as possible to the CRM and the upper first molars.	14 hours/day	250g on each side (initially), gradually increasing up to 300 g
Mazali, 2011	Cephalometric analysis	HG conjugated to the encapsulated expansion plate, by means of a telescopic tube inserted in the palatal region, with the external arm of the device parallel to the occlusal plane. An ES placed between the deciduous molars and the maxillary first molars and a Hawley buccal arch made of 0.7mm stainless steel wire were also used.	Medium high pull with F directed as close as possible to the CRM and the upper first molars.	16 hours/day	400 to 500 g on each side
Jacob, 2014	Cephalometric analysis	HG fixed to the acrylic plate, with ES at the level of the deciduous second molars. Hawley buccal arch fixed to the plate and palatal crib in some cases.	High pull with F directed slightly posterior to the CRM.	14 hours/day	400g on each side

MTA: Modified Thurow appliance; OP: occlusal plane; OB: open bite; HG: headgear; ES: expansion screw F: force; CRM: center of resistance of the

Table 3. Main outcomes and conclusions of the included studies.

Author, year	Dental / skeletal changes	Conclusions
Fotis, 1984	• Obtaining the normal interincisal relationship; • Reduction of the overjet; • Improvement of the molar relationship (-4.9mm; $p < 0.01$); • Improvement of the skeletal discrepancy (ss-n-sm -2,0º; $p < 0.01$); • PFH/AFH showed no significant change (0,2; $p < 0.01$); • Restriction of the vertical development of the nasomaxillary complex (mol-NSL); • Increase in height of the alveolar process of the mandible; • Posterior tipping of the palatal plane; • Maintenance of the growth pattern (Y-axis 0.3º).	The treatment results showed the importance of the maximum vertical control, since several positive effects and no harmful effects could be verified in relation to the skeletal pattern. However, a post-treatment study is needed to clarify the full impact of the vertical forces applied during craniofacial growth.
Fotis, 1985	• The original prognathism (s-n-sm, s-n-pg, Y axis) and mandibular inclination were inversely correlated with the changes that occurred after treatment ($P < 0.05$). The original position of the mandible was also reflected in the inverse correlation observed in relation to PFH/AFH ($P < 0.05$). • Significant inverse correlation between the original and post-treatment values of the changes in the incisor protrusion (iss-FP) and molar relationship (mol rel). • Mandible forward displacement greater than that of the maxilla during treatment. After treatment, the opposite trend was observed. • During treatment the maxillary molars did not erupt in relation to the PP, while after treatment, the vertical development of the maxillary molar region was similar to that of the mandible.	Relapse occurred immediately after discontinuation of the forces that restricted the sagittal and vertical maxillary development, although the skeletal relapse is not always followed by the dental relapse.
De Baets, 1995	• Obtaining bilateral Class I molar and canine relationships; • Anterior OB closure; • Improvement of the sagittal skeletal relationships (ANB was reduced by 2.62°, mostly due to a 2.36° reduction of SNA ($p < .01$), while SNB remained virtually unchanged); • Reduction of the angle Spa-Spp/MGo by 3.19° ($p < .01$); • Craniomandibular plane angle (SN/MGo) showed no significant change (mean decrease of .81°); • Inclination of the PP, which rotated 2.56° clockwise relative to SN ($p < .01$).	The high-pull headgear-plate seems to be indicated for the treatment of patients with skeletal Class II malocclusions due to maxillary protrusion and associated with the anterior OB and a vertical growth pattern. However, further studies are needed to assess the stability of early Class II correction, particularly to determine whether an active retention period can control the growth expression and relapse.

Author, year	Dental / skeletal changes	Conclusions
Paulin, 2008	• Significant improvement in the maxillomandibular relationship; • Overjet reduction; • Significant dentoalveolar maxillary restriction with slight change in the maxillary bone base growth; • Increase in total mandibular length, mandibular body and mandibular ramus height; • Anteroinferior displacement of the mandible with decreased inclination of the MP; • Increase in the AFH and PFH; • Overbite increase and OP clockwise rotation, correcting anterior OB; • Correction of molar Class II, by distal displacement of the upper molars and natural mesial displacement of the lower molars. • Significant uprighting of the upper and lower incisors.	The effects of the MTA in the correction of Class II malocclusions are predominantly dentoalveolar, associated with clockwise rotation of the PP and counterclockwise rotation of the MP.
Garbui, 2010	• No statistically significant difference between the pre- and posttreatment values of the OP angle (–0.47° ± 2.45° for females and –0.73° ± 3.34° for males); • No statistically significant difference between the pre- and posttreatment values of the SN.MP angle (–0.67° ± 2.48° for females and –0.60° ± 2.26° for males); • Reduction in the values for Y-axis (–0.83° ± 1.38° for women and –0.47° ± 1.85° for men), PP.MP (–2.03° ± 1.89° for women and –0.60° ± 2.86° for men) and FMA (–2.46° ± 1.76° for women and –1.13° ± 2.06° for men); • Statistically significant increase in the SN.PP angle (0.77° ± 1.02° for women and 0.23° ± 1.13° for men); • Increase of the AFH (1.80 ± 2.14 mm for women and 2.20 ± 1.74 mm for men) and PFH values (1.60 ± 2.26 mm for women and 2.67 ± 2.61 mm for men), but remaining proportional to each other, with no change in facial hyperdivergence.	The divergence in the facial lower third of the patients did not increase, suggesting that the combined extraoral appliance with the line of F application directed to the CRM was effective in treating Angle Class II malocclusion in hyperdivergent subjects.
Mazali, 2011	• Reduction of the maxillary protrusion, although SNA was not statistically significant; • Sagittal facial changes with control of the anterior maxillary growth (increase in SNB and decrease in the ANB angle); • Favorable change in the mandibular growth (statistically significant increase in mandibular length (C-mand), mandibular body length (Go-Me) and length of the ramus of the mandible (Go-Cd)); • Significant increase in the AFH, PFH and facial height index; • Significant reductions in SN.Gn, FMA and SN.GoMe (although there was, clinically, the maintenance of the facial pattern).	The therapy with headgear coupled with palatal expander is an efficient option for treating hyperdivergent patients with Angle's Class II Division 1 malocclusion associated with OB, because it controls the vertical growth of the lower third of the face, which reduced the maxillomandibular gap by restricting the maxillary growth and encouraging the mandibular growth.

Author, year	Dental / skeletal changes	Conclusions
Jacob, 2014	• The SNA angle decreased in the treated group (-0,94º; p < 0,05) and remained unchanged in the C (0,03º; p < 0,05); • The ANB angle significantly decreased more in treated patients (-1,10º; p < 0,05) than in the C group (-0,12º; p < 0,05); • The SNA angle decreased in the treated group (-2,75º; p < 0,05) and remained unchanged in the C (0,08º; p < 0,05); • The PP angle increased in the treated group (2,14º; p < 0,05) and remained unchanged in the C (0,07º; p < 0,05); • Significantly greater decrease in the PP/MP of the treated group (-2,73º; p < 0,05) than C (-0,23º; p < 0,05); • LFH (ANS-Me) decreased in the experimental group (-0,92mm; p < 0,05) and increased in the C group (1,14mm; p < 0,05); • PNS showed slight superior drift in the treated group (-0,50mm) and inferior drift in the C group (0,21mm), with statistically significant differences (p = 0,001); • The maxillary molars of the treated group showed no vertical changes, whereas in the C group erupted approximately 0.8 mm.	The MTA controlled the vertical and horizontal displacements of the maxilla, rotated the maxilla and improved the OB malocclusion, decreasing the LFH.

MTA: Modified Thurow appliance; F: force; CRM: center of resistance of the maxilla; OB: open bite; C: control; OP: occlusal plane; PP: palatal plane; MP: mandibular plane; AFH: anterior facial height; PFH: posterior facial height; LFH: lower face height.

4 CONCLUSÃO

Diante dos resultados obtidos na presente pesquisa, pode-se concluir que:

1. A utilização de diferentes medidas cefalométricas interferiu na determinação do padrão facial de indivíduos Classe II/1 em fase de crescimento, tratados com o TM;

2. Após a utilização do TM no tratamento da Classe II/1, a dimensão vertical de indivíduos hiperdivergentes não aumentou, indicando a manutenção do padrão facial, embora tenha havido uma inibição do desenvolvimento vertical da maxila, principalmente na região posterior, com rotação anti-horária da mandíbula;

3. Após a utilização do TM no tratamento da Classe II/1 de indivíduos hiperdivergentes, houve a correção da mordida aberta;

4. Após a utilização do TM no tratamento da Classe II/1 de indivíduos hiperdivergentes, houve uma redução significativa da sobressaliência;

5. Após a utilização do TM no tratamento da Classe II/1 de indivíduos hiperdivergentes, houve uma melhora da relação interincisal;

6. Após a utilização do TM no tratamento da Classe II/1 de indivíduos hiperdivergentes, houve o estabelecimento da relação de Classe I posterior, com uma melhora da relação entre maxila e mandíbula.

REFERÊNCIAS

ALMEIDA-PEDRIN, R.R; ALMEIDA, M.R; ALMEIDA, R.R; PINZAN, A.; FERREIRA, F.P. Treatment effects of headgear biteplane and bionator appliances. **Am J Orthod Dentofac Orthop**., v. 132, n. 2, p. 191-8, 2007.

ANGLE, E.H. Classification of malocclusion. **Dent Cosmos**., v. 41, p. 350-75, 1899.

BACCETTI, T.; FRANCHI, L.; MCNAMARA JR, J.A.; TOLLARO, I. Early dentofacial features of Class II malocclusion: A longitudinal study from the deciduous through the mixed dentition. **Am J Orthod Dentofac Orthop**., v. 111, n. 5, p. 502-9, 1997.

BAUMRIND, S.; KORN, E.L.; MOLTHEN, R.; WEST, E.E. Changes in facial dimensions associated with the use of forces to retract the maxilla. **Am J Orthod**., v. 80, n. 1, p. 17-30, 1981.

BAUMRIND, S.; KORN, E.L.; ISAACSON, R.J.; WEST, E.E.; MOLTHEN, R. Quantitative analysis of the orthodontic and orthopedic effects of maxillary traction. **Am J Orthod**., v. 84, n. 5, p. 384-98, 1983

BERNABÉ, E.; SHEIHAMB, A.; OLIVEIRA, C.M. Condition-Specific Impacts on Quality of Life Attributed to Malocclusion by Adolescents with Normal Occlusion and Class I, II and III Malocclusion. **Angle Orthod**., v. 78, n. 6, p. 977-82, 2008.

BISHARA, S.E. Class II Malocclusions: Diagnostic and Clinical Considerations With and Without Treatment. **Semin Orthod**., v. 12, n. 1, p. 11-24, 2006.

CALDWELL, S.F.; HYMAS, A.; TIMM, T.A. Maxillary traction splint: a cephalometric evaluation. **Am J Orthod**., v. 85, n. 5, p. 376-84, 1984.

CREEKMORE, T.D. Inhibition or stimulation of the vertical growth of the facial complex, its significance to treatment. **Angle Orthod**., v. 37, n. 4, p. 285-97, 1967.

DEL SANTO, M.; JACOB, H.; BÓSIO, J.A. O desafio do tratamento ortodôntico do paciente com fenótipo facial hiperdivergente. **Rev Assoc Paul Cir Dent**., v. 70, p. 204-9, 2016.

FERNANDES, A.F.; BRUNHARO, I.H.; QUINTÃO, C.C.; COSTA, M.G.; OLIVEIRA-COSTA, M.R. Effectiveness of twin blocks and extraoral maxillary splint (Thurow) appliances for the correction of class II relationships. **World J Orthod**., v. 11, n. 3, p. 230-5, 2010.

FIROUZ, M.; ZERNIK, J.; NANDA, R. Dental and orthopedic effects of high-pull headgear in treatment of Class II, in Division 1 malocclusion. **Am J Orthod Dentofac Orthop**., v. 102, n. 3, p. 197-205, 1992.

FONTES, F.P.; BELLINI-PEREIRA, S.A.; ALIAGA-DEL-CASTILLO, A.; PATEL, M.P.; FREITAS, M.R.; HENRIQUES, J.F.; JANSON, G. Comparison of the dentoskeletal and soft tissue changes with the cervical headgear and Jones Jig followed by fixed appliances in Class II malocclusion patients: A retrospective study. **Int Orthod**., v. 18, n. 3, p. 424-35, 2020.

FOTIS, V.; MELSEN, B.; WILLIAMS, S.; DROSCHL, H. Vertical control as an important ingredient in the treatment of severe sagittal discrepancies. **Am J Orthod**., v. 86, p. 224-32, 1984.

FREJMAN, M.W.; VARGAS, I.A.; RÖSING, C.K.; CLOSS, L.Q. Dentofacial Deformities Are Associated With Lower Degrees of Self-Esteem and Higher Impact on Oral Health-Related Quality of Life: Results From an Observational Study Involving Adults. **J Oral Maxillofac Surg**., v. 71, p. 763-7, 2013.

GARBUI, I.U.; NOUER, P.R.; NOUER, D.F.; MAGNANI, M.B.; PEREIRA NETO, J.S.; Cephalometric assessment of vertical control in the treatment of class II malocclusion with a combined maxillary splint. **Braz Oral Res**., v. 24, n. 1, p. 34-9, 2010.

GEBECK, T.R.; MERRIFIELD, L.L. Orthodontic diagnosis and treatment analysis-concepts and values: Part II. **Am J Orthod Dentofac Orthop**., v. 107, n. 5, p. 541-7, 1995.

HENRIQUES, J.F.; MARTINS, D.R.; ALMEIDA, G.A.; URSI, W.J. Modified maxillary splint for Class II, Division 1 treatment. **J Clin Orthod**., v. 25, p. 239-45, 1991.

HORN, A.J. Facial height index. **Am J Orthod Dentofac Orthop**., v. 102, n. 2, p. 180-6, 1992.

JACOB, H.B.; SANTOS-PINTO, A.; BUSCHANG, P.H. Dental and skeletal components of Class II open bite treatment with a modified Thurow appliance. **Dental Press J Orthod**., v. 19, n. 1, p. 19-25, 2014.

JOFFE, L.; JACOBSON, A. The maxillary orthopedic splint. **Am J Orthod**., v. 75, p. 54-69, 1979.

MARTINS, R.P.; MARTINS, J.C.; MARTINS, L.P.; BUSCHANG, P.H. Skeletal and dental components of Class II correction with the bionator and removable headgear splint appliances. **Am J Orthod Dentofac Orthop**., v. 134, p. 732-41, 2008.

MCNAMARA JR, J.A.; PETERSON, J.E.; ALEXANDER, R.G. Three-Dimensional Diagnosis and Management of Class II Malocclusion in the Mixed Dentition. **Semin Orthod**., v. 2, n. 2, p. 114-37, 1996.

MELSEN, B. Effects of cervical anchorage during and after treatment: An implant study. **Am J Orthod**., v. 73, n. 5, p. 526-40, 1978.

MIGUEL, J.A.; MASUCCI, C.; FERNANDES, L.Q.; ARTESE, F.; FRANCHI, L.; GIUNTINI, V. Dentoskeletal effects of the maxillary splint headgear in the early correction of Class II malocclusion. **Prog Orthod**., v. 21, n. 1, p. 1-10, 2020. Disponível em: https://doi.org/10.1186/s40510-020-00311-x

PITHON, M.M.; SANTOS, R.L.; SAMPAIO, G.A.; MENESES, I.H.; COQUEIRO, R.S. Anteroposterior and vertical changes in skeletal class II patients treated with modified Thurow appliance. **Braz Dent J**., v. 25, n. 2, p. 170-4, 2014.

ROSENBLUM, R.E. Class II malocclusion: mandibular retrusion or maxillary protrusion? **Angle Orthod**., v. 65, n. 1, p. 49-62, 1995.

SANTOS-PINTO, A.; MARTINS, L.P.; MELO, A.C.; PAULIN, R.F.; OSHIRO, L. O Aparelho Extra-Bucal de Thurow Modificado no Tratamento da Classe II com Mordida Aberta - Caso Clínico. **R Dental Press Ortodon Ortop Facial**., v. 6, n. 1, p. 57-62, 2001.

SEÇKIN, Ö.; SURUCU, R. Treatment of Class 11, division 1, cases with a maxillary traction splint. **Quintessence Int**., v. 21, n. 3, p. 209-15, 1990.

SEEHRA, J.; FLEMING, P.S.; NEWTON, T.; DIBIASE, A.T. Bullying in orthodontic patients and its relationship to malocclusion, self-esteem and oral health-related quality of life. **J Orthod**., v. 38, p. 247-56, 2011.

SILVESTRINI-BIAVATI, S.; LAZZAROTTI, L.; BINI, S.; MIGLIORATI, M.; UGOLINI, A. Maxillary "en masse" high-pull traction in Class II division 1 subjects: which kind of skeletal outcomes does it produce? **Eur J Paediatr Dent**., v. 21, p. 271-6, 2020.

STUANI, M.B.; STUANI, A.S.; STUANI, A.S. Modified Thurow appliance: a clinical alternative for correcting skeletal open bite. **Am J Orthod Dentofac Orthop**., v. 128, p. 118-25, 2005.

THUROW, R.C. Craniomaxillary orthopedic correction with en masse dental control. **Am J Orthod**., v. 68, n. 6, p. 601-24, 1975.

ÜNER, O.; YÜCEL-EROGLU, E. Effects of a modified maxillary orthopaedic splint: a cephalometric evaluation. **Eur J Orthod**., v. 18, p. 269-86, 1996.

ANEXO A – PARECER CONSUBSTANCIADO DO CEP

Universidade Federal do Ceará
Comitê de Ética em Pesquisa

Of. Nº 051/11 Fortaleza, 25 de março de 2011
Protocolo COMEPE nº 043/11
Pesquisador responsável: Pedro César Fernandes dos Santos
Título do Projeto: "Avaliação cefalométrica e da severidade das más oclusões promovidas pelo aparelho extrabucal de Thurow em indivíduos com má oclusão de classe II 1ª divisão"

Levamos ao conhecimento de V.Sª. que o Comitê de Ética em Pesquisa da Universidade Federal do Ceará – COMEPE, dentro das normas que regulamentam a pesquisa em seres humanos, do Conselho Nacional de Saúde – Ministério da Saúde, Resolução nº 196 de 10 de outubro de 1996 e complementares, aprovou o protocolo e o TCLE do projeto supracitado na reunião do dia 24 de março de 2011.

Outrossim, informamos, que o pesquisador deverá se comprometer a enviar o relatório final do referido projeto.

Atenciosamente,

Dr. Fernando A. Frota Mota
Coordenador do Comitê de Ética em Pesquisa
COMEPE/UFC

ANEXO B – DIRETRIZES PARA PUBLICAÇÃO NA DENTAL PRESS JOURNAL ORTHODONTICS

Forma e preparação de manuscritos

O Dental Press Journal of Orthodontics publica artigos de investigação científica, revisões significativas, relatos de casos clínicos e de técnicas, comunicações breves e outros materiais relacionados à Ortodontia e Ortopedia Facial.

ORIENTAÇÕES PARA SUBMISSÃO DE MANUSCRITOS

- Submeta os artigos através do site http://dpjo.dentalpresspub.com/. Organize sua apresentação como descrito a seguir:

1. Página de título

- deve conter título em português e inglês, resumo e abstract, palavras-chave e keywords.
- coloque todas as informações relativas aos autores em uma página separada, incluindo: nomes completos dos autores, títulos acadêmicos, afiliações institucionais e cargos administrativos. Ainda, deve-se identificar o autor correspondente e incluir seu endereço, números de telefone e e-mail. Essa informação não estará disponível para os revisores.

2. Resumo/Abstract

- os resumos estruturados, em português e inglês, de 250 palavras ou menos são os preferidos.
- os resumos estruturados devem conter as seguintes seções: INTRODUÇÃO, apresentando a proposição do estudo; MÉTODOS, descrevendo como o mesmo foi realizado; RESULTADOS, descrevendo os resultados primários; e CONCLUSÕES, relatando o que os autores concluíram dos resultados, além das implicações clínicas.
- os resumos devem ser acompanhados de 3 a 5 palavras-chave, ou descritores, também em português e em inglês, as quais devem ser adequadas conforme MeSH/DeCS.

3. Texto

- o texto deve ser organizado nas seguintes seções: Introdução, Material e Métodos, Resultados, Discussão, Conclusões, Referências, e Legendas das figuras.
- os textos devem ter o número máximo de 4.000 palavras, incluindo legendas das figuras, resumo, abstract e referências.
- envie figuras e tabelas em arquivos separados (ver abaixo).

- também insira as legendas das figuras no corpo do texto, para orientar a montagem final do artigo.

4. Figuras

- as imagens digitais devem ser no formato JPG ou TIF, em CMYK ou tons de cinza, com pelo menos 7 cm de largura e 300 dpis de resolução.
- as imagens devem ser enviadas em arquivos independentes.
- se uma figura já foi publicada anteriormente, sua legenda deve dar todo o crédito à fonte original.
- confirmar se todas as figuras foram citadas no texto.

5. Gráficos e traçados cefalométricos

- devem ser enviados os arquivos contendo as versões originais dos gráficos e traçados, nos programas que foram utilizados para sua confecção.
- não é recomendado o envio dos mesmos apenas em formato de imagem bitmap (não editável).
- os desenhos enviados podem ser melhorados ou redesenhados pela produção da revista, a critério do Corpo Editorial.

6. Tabelas

- as tabelas devem ser autoexplicativas e devem complementar, e não duplicar o texto.
- devem ser numeradas com algarismos arábicos, na ordem em que são mencionadas no texto.
- forneça um breve título para cada uma.
- se uma tabela tiver sido publicada anteriormente, inclua uma nota de rodapé dando crédito à fonte original.
- apresente as tabelas como arquivo de texto (Word ou Excel, por exemplo) e não como elemento gráfico (imagem não editável).

7. Declaração de Cessão de Direitos Autorais

- todos os manuscritos devem ser acompanhados da seguinte declaração escrita, assinada por todos os autores: "O(s) autor(es) abaixo assinado(s) transfere(m) todos os direitos autorais do manuscrito [inserir título do artigo aqui] para a Dental Press International, caso o trabalho seja publicado. O(s) autor(es) abaixo assinado(s) garante(m) que o artigo é original, não infringe qualquer direito autoral ou outro direito de propriedade de terceiros, não está sendo analisado por outra revista e não foi publicado anteriormente, seja em mídia impressa ou eletrônica. Eu

(nós) assino (assinamos) e aceito (aceitamos) a responsabilidade de publicar este material."- digitalize esse termo de liberação de direitos autorais e o envie pelo site*, junto com o artigo.

8. Comitês de Ética

- Os artigos devem, se aplicável, fazer referência a pareceres de Comitês de Ética.

9. Referências

- todos os artigos citados no texto devem constar na lista de referências.
- todas as referências listadas devem ser citadas no texto.
- com o objetivo de facilitar a leitura do texto, as referências serão citadas no texto apenas indicando a sua numeração.
- as referências devem ser identificadas no texto por números arábicos sobrescritos e numeradas na ordem em que são citadas no texto.
- as abreviações dos títulos dos periódicos devem ser normalizadas de acordo com as publicações "Index Medicus" e "Index to Dental Literature".
- a exatidão das referências é de responsabilidade dos autores; as mesmas devem conter todos os dados necessários à sua identificação.
- as referências devem ser apresentadas no final do texto obedecendo às Normas Vancouver (http://www.nlm.nih.gov/bsd/uniform_requirements.html).
- não devem ultrapassar o limite de 30.

Artigos com um até seis autores

Sterrett JD, Oliver T, Robinson F, Fortson W, Knaak B, Russell CM. Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man. J Clin Periodontol. 1999 Mar;26(3):153-7.

Artigos com mais de seis autores

De Munck J, Van Landuyt K, Peumans M, Poitevin A, Lambrechts P, Braem M, et al. A critical review of the durability of adhesion to tooth tissue: methods and results. J Dent Res. 2005 Feb;84(2):118-32.

Capítulo de livro

Kina S. Preparos dentários com finalidade protética. In: Kina S, Brugnera A. Invisível: restaurações estéticas cerâmicas. Maringá: Dental Press; 2007. cap. 6, p. 223-301.

Capítulo de livro com editor

Breedlove GK, Schorfheide AM. Adolescent pregnancy. 2ª ed. Wieczorek RR, editor. White Plains (NY): March of Dimes Education Services; 2001.

Dissertação, tese e trabalho de conclusão de curso

Beltrami LER. Braquetes com sulcos retentivos na base, colados clinicamente e removidos em laboratórios por testes de tração, cisalhamento e torção. [dissertação]. Bauru: Universidade de São Paulo; 1990.

Formato eletrônico

Câmara CALP. Estética em Ortodontia: Diagramas de Referências Estéticas Dentárias (DRED) e Faciais (DREF). Rev Dental Press Ortod Ortop Facial. 2006 nov-dez;11(6):130-56. [Acesso 12 jun 2008]. Disponível em: www.scielo.br/pdf/dpress/v11n6/a15v11n6.pdf.

Enfatizamos, ainda, que não há cobranças de taxas (APC - Article Processing Charge) para submissão, avaliação ou publicação dos artigos.

Envio de manuscritos

O Dental Press Journal of Orthodontics utiliza o ScholarOne, um sistema online de submissão e avaliação de trabalhos. Para submeter novos trabalhos visite o site: https://mc04.manuscriptcentral.com/dpjo-scielo.

ANEXO C - DIRETRIZES PARA PUBLICAÇÃO NA REVISTA PROGRESS IN ORTHODONTICS

Submission guidelines

Review Article

Criteria

Review articles are summaries of recent insights in specific research areas within the scope of Progress in Orthodontics. Key aims of Review articles are to provide systematic and substantial coverage of mature subjects, evaluations of progress in specified areas, and/or critical assessments of emerging technologies.

Progress in Orthodontics does not implement a word count on Review Articles accepted for publication.

Preparing your manuscript

Title page

The title page should:

present a title that includes, if appropriate, the study design e.g.:

"A versus B in the treatment of C: a randomized controlled trial", "X is a risk factor for Y: a case control study", "What is the impact of factor X on subject Y: A systematic review".

or for non-clinical or non-research studies: a description of what the article reports.

list the full names and institutional addresses for all authors

if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the “Acknowledgements” section in accordance with the instructions below.

indicate the corresponding author.

Abstract

The abstract should not exceed 350 words and should be structured with a background, main body of the abstract and short conclusion. Please minimize the use of abbreviations and do not cite references in the abstract.

Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should explain the background to the article, its aims, a summary of a search of the existing literature and the issue under discussion.

Main text

This should contain the body of the article, and may also be broken into subsections with short, informative headings.

Conclusions

This should state clearly the main conclusions and include an explanation of their relevance or importance to the field.

List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations should be provided.

Declarations

All manuscripts must contain the following sections under the heading 'Declarations':

- Ethics approval and consent to participate
- Consent for publication
- Availability of data and material
- Competing interests
- Funding
- Authors' contributions
- Acknowledgements
- Authors' information (optional)

Please see below for details on the information to be included in these sections.

If any of the sections are not relevant to your manuscript, please include the heading and write 'Not applicable' for that section.

Ethics approval and consent to participate

Manuscripts reporting studies involving human participants, human data or human tissue must:

- include a statement on ethics approval and consent (even where the need for approval was waived)
- include the name of the ethics committee that approved the study and the committee's reference number if appropriate

Studies involving animals must include a statement on ethics approval.

See our editorial policies for more information.

If your manuscript does not report on or involve the use of any animal or human data or tissue, please state "Not applicable" in this section.

Consent for publication

If your manuscript contains any individual person's data in any form (including individual details, images or videos), consent to publish must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent to publish.

You can use your institutional consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication).

See our editorial policies for more information on consent for publication.

If your manuscript does not contain data from any individual person, please state "Not applicable" in this section.

Availability of data and materials

All manuscripts must include an 'Availability of data and materials' statement. Data availability statements should include information on where data supporting the results reported in the article can be found including, where applicable, hyperlinks to publicly archived datasets analysed or generated during the study. By data we mean the minimal dataset that would be necessary to interpret, replicate and build upon the findings reported in the article. We recognise it is not always possible to share research data publicly, for instance when individual privacy could be compromised, and in such instances data availability should still be stated in the manuscript along with any conditions for access.

Data availability statements can take one of the following forms (or a combination of more than one if required for multiple datasets):

- The datasets generated and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS]
- The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
- All data generated or analysed during this study are included in this published article [and its supplementary information files].
- The datasets generated and/or analysed during the current study are not publicly available due [REASON WHY DATA ARE NOT PUBLIC] but are available from the corresponding author on reasonable request.
- Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.
- The data that support the findings of this study are available from [third party name] but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [third party name].
- Not applicable. If your manuscript does not contain any data, please state 'Not applicable' in this section.

More examples of template data availability statements, which include examples of openly available and restricted access datasets, are available here.

SpringerOpen also requires that authors cite any publicly available data on which the conclusions of the paper rely in the manuscript. Data citations should include a persistent identifier (such as a DOI) and should ideally be included in the reference list. Citations of datasets, when they appear in the reference list, should include the minimum information recommended by DataCite and follow journal style. Dataset identifiers including DOIs should be expressed as full URLs. For example:

Hao Z, AghaKouchak A, Nakhjiri N, Farahmand A. Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare. 2014. http://dx.doi.org/10.6084/m9.figshare.853801

With the corresponding text in the Availability of data and materials statement:

The datasets generated during and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].[Reference number]

Competing interests

All financial and non-financial competing interests must be declared in this section.
See our editorial policies for a full explanation of competing interests. If you are unsure whether you or any of your co-authors have a competing interest please contact the editorial office.
Please use the authors' initials to refer to each authors' competing interests in this section.
If you do not have any competing interests, please state "The authors declare that they have no competing interests" in this section.

Funding

All sources of funding for the research reported should be declared. The role of the funding body in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript should be declared.

Authors' contributions

The individual contributions of authors to the manuscript should be specified in this section. Guidance and criteria for authorship can be found in our editorial policies.
Please use initials to refer to each author's contribution in this section, for example: "FC analyzed and interpreted the patient data regarding the hematological disease and the transplant. RH performed the histological examination of the kidney, and was a major contributor in writing the manuscript. All authors read and approved the final manuscript."

Acknowledgements

Please acknowledge anyone who contributed towards the article who does not meet the criteria for authorship including anyone who provided professional writing services or materials.
Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.
See our editorial policies for a full explanation of acknowledgements and authorship criteria.
If you do not have anyone to acknowledge, please write "Not applicable" in this section.
Group authorship (for manuscripts involving a collaboration group): if you would like the names of the individual members of a collaboration Group to be searchable through their individual PubMed records, please ensure that the title of the collaboration Group is included on the title page and in the submission system and also include collaborating author names as the last paragraph of the "Acknowledgements" section. Please add authors in the format First Name, Middle initial(s) (optional), Last Name. You can add institution or country information for each author if you wish, but this should be consistent across all authors.

Please note that individual names may not be present in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Authors' information

This section is optional.

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

Footnotes

Footnotes should be designated within the text using a superscript number. It is not allowed to use footnotes for references/citations.

References

Examples of the Vancouver reference style are shown below.

See our editorial policies for author guidance on good citation practice.

Web links and URLs: All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the manuscript. They should be provided in full, including both the title of the site and the URL, as well as the date the site was accessed, in the following format: The Mouse Tumor Biology Database. http://tumor.informatics.jax.org/mtbwi/index.do. Accessed 20 May 2013. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

Example reference style:

Article within a journal

Smith JJ. The world of science. Am J Sci. 1999;36:234-5.

Article within a journal (no page numbers)

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine. 2013;11:63.

Article within a journal by DOI

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. Dig J Mol Med. 2000; doi:10.1007/s801090000086.

Article within a journal supplement

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. Blood 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. International review of cytology. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. Top Curr Chem. 2007. doi:10.1007/128_2006_108.

Complete book, authored

Blenkinsopp A, Paxton P. Symptoms in the pharmacy: a guide to the management of common illness. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: The dictionary of substances and their effects. Royal Society of Chemistry. 1999. http://www.rsc.org/dose/title of subordinate document. Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. http://www.healthwise.org. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. http://www.privatehomepage.com. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. http://www.uni-heidelberg.de/mydata.html (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. ftp://ftp.isi.edu/in-notes/rfc2169.txt (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. http://www.issn.org (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (Sorghum bicolor). GigaScience Database. 2011. http://dx.doi.org/10.5524/100012.

General formatting information

Manuscripts must be written in concise English. For help on scientific writing, or preparing your manuscript in English, please see Springer's Author Academy.

Quick points:

- Use double line spacing
- Include line and page numbering
- Use SI units: Please ensure that all special characters used are embedded in the text, otherwise they will be lost during conversion to PDF
- Do not use page breaks in your manuscript

File formats

The following word processor file formats are acceptable for the main manuscript document:

- Microsoft word (DOC, DOCX)
- Rich text format (RTF)
- TeX/LaTeX (use either BioMed Central's TeX template)

Please note: editable files are required for processing in production. If your manuscript contains any non-editable files (such as PDFs) you will be required to re-submit an editable file if your manuscript is accepted.

For more information, see 'Preparing figures' below.

Additional information for TeX/LaTeX users

Please use either BioMed Central's TeX template and BibTeX stylefile if you use TeX format. Submit your references using either a bib or bbl file. When submitting TeX submissions, please submit both your TeX file and your bib/bbl file as manuscript files. Please also convert your TeX file into a PDF (please do not use a DIV file) and submit this PDF as a supplementary file with the name 'Reference PDF'. This PDF will be used by our production team as a reference point to check the layout of the article as the author intended. Please also note that all figures must be coded at the end of the TeX file and not inline.

The Editorial Manager system checks for any errors in the Tex files. If an error is present then the system PDF will display LaTex code and highlight and explain the error in a section beginning with an exclamation mark (!).

All relevant editable source files must be uploaded during the submission process. Failing to submit these source files will cause unnecessary delays in the production process.

TeX templates:

- BioMedCentral_article (ZIP format) - preferred template
- article (part of the standard TeX distribution)
- amsart (part of the standard TeX distribution)

Style and language

For editors and reviewers to accurately assess the work presented in your manuscript you need to ensure the English language is of sufficient quality to be understood. If you need help with writing in English you should consider:

- Getting a fast, free online grammar check.
- Visiting the English language tutorial which covers the common mistakes when writing in English.

- Asking a colleague who is proficient in English to review your manuscript for clarity.
- Using a professional language editing service where editors will improve the English to ensure that your meaning is clear and identify problems that require your review. Two such services are provided by our affiliates Nature Research Editing Service and American Journal Experts. SpringerOpen authors are entitled to a 10% discount on their first submission to either of these services. To claim 10% off English editing from Nature Research Editing Service, click here. To claim 10% off American Journal Experts, click here.

Please note that the use of a language editing service is not a requirement for publication in Progress in Orthodontics and does not imply or guarantee that the article will be selected for peer review or accepted.

Preparing figures

- When preparing figures, please follow the formatting instructions below.
- Figure titles (max 15 words) and legends (max 300 words) should be provided in the main manuscript, not in the graphic file.
- Tables should NOT be submitted as figures but should be included in the main manuscript file.
- Multi-panel figures (those with parts a, b, c, d etc.) should be submitted as a single composite file that contains all parts of the figure.
- Figures should be numbered in the order they are first mentioned in the text, and uploaded in this order.
- Figures should be uploaded in the correct orientation.
- Figure keys should be incorporated into the graphic, not into the legend of the figure.
- Each figure should be closely cropped to minimize the amount of white space surrounding the illustration. Cropping figures improves accuracy when placing the figure in combination with other elements when the accepted manuscript is prepared for publication on our site. For more information on individual figure file formats, see our detailed instructions.
- Individual figure files should not exceed 10 MB. If a suitable format is chosen, this file size is adequate for extremely high quality figures.
- Please note that it is the responsibility of the author(s) to obtain permission from the copyright holder to reproduce figures (or tables) that have previously been published

elsewhere. In order for all figures to be open access, authors must have permission from the rights holder if they wish to include images that have been published elsewhere in non open access journals. Permission should be indicated in the figure legend, and the original source included in the reference list.

Figure file types

We accept the following file formats for figures:

- EPS (suitable for diagrams and/or images)
- PDF (suitable for diagrams and/or images)
- Microsoft Word (suitable for diagrams and/or images, figures must be a single page)
- PowerPoint (suitable for diagrams and/or images, figures must be a single page)
- TIFF (suitable for images)
- JPEG (suitable for photographic images, less suitable for graphical images)
- PNG (suitable for images)
- BMP (suitable for images)
- CDX (ChemDraw - suitable for molecular structures)

Figure size and resolution

Figures are resized during publication of the final full text and PDF versions to conform to the SpringerOpen standard dimensions, which are detailed below.

Figures on the web:

- width of 600 pixels (standard), 1200 pixels (high resolution).

Figures in the final PDF version:

- width of 85 mm for half page width figure
- width of 170 mm for full page width figure
- maximum height of 225 mm for figure and legend
- image resolution of approximately 300 dpi (dots per inch) at the final size

Figures should be designed such that all information, including text, is legible at these dimensions. All lines should be wider than 0.25 pt when constrained to standard figure widths. All fonts must be embedded.

Figure file compression

Vector figures should if possible be submitted as PDF files, which are usually more compact than EPS files.

- TIFF files should be saved with LZW compression, which is lossless (decreases file size without decreasing quality) in order to minimize upload time.
- JPEG files should be saved at maximum quality.
- Conversion of images between file types (especially lossy formats such as JPEG) should be kept to a minimum to avoid degradation of quality.

If you have any questions or are experiencing a problem with figures, please contact the customer service team at info@springeropen.com.

Preparing tables

When preparing tables, please follow the formatting instructions below.

- Tables should be numbered and cited in the text in sequence using Arabic numerals (i.e., Table 1, Table 2 etc.).
- Tables less than one A4 or Letter page in length can be placed in the appropriate location within the manuscript.
- Tables larger than one A4 or Letter page in length can be placed at the end of the document text file. Please cite and indicate where the table should appear at the relevant location in the text file so that the table can be added in the correct place during production.
- Larger datasets, or tables too wide for A4 or Letter landscape page can be uploaded as additional files. Please see [below] for more information.
- Tabular data provided as additional files can be uploaded as an Excel spreadsheet (.xls) or comma separated values (.csv). Please use the standard file extensions.
- Table titles (max 15 words) should be included above the table, and legends (max 300 words) should be included underneath the table.
- Tables should not be embedded as figures or spreadsheet files, but should be formatted using ‘Table object’ function in your word processing program.
- Color and shading may not be used. Parts of the table can be highlighted using superscript, numbering, lettering, symbols or bold text, the meaning of which should be explained in a table legend.
- Commas should not be used to indicate numerical values.

If you have any questions or are experiencing a problem with tables, please contact the customer service team at info@springeropen.com.

Preparing additional files

As the length and quantity of data is not restricted for many article types, authors can provide datasets, tables, movies, or other information as additional files.

All Additional files will be published along with the accepted article. Do not include files such as patient consent forms, certificates of language editing, or revised versions of the main manuscript document with tracked changes. Such files, if requested, should be sent by email to the journal's editorial email address, quoting the manuscript reference number.

Results that would otherwise be indicated as "data not shown" should be included as additional files. Since many web links and URLs rapidly become broken, SpringerOpen requires that supporting data are included as additional files, or deposited in a recognized repository. Please do not link to data on a personal/departmental website. Do not include any individual participant details. The maximum file size for additional files is 20 MB each, and files will be virus-scanned on submission. Each additional file should be cited in sequence within the main body of text.