UNIVERSIDADE FEDERAL DO PARANÁ

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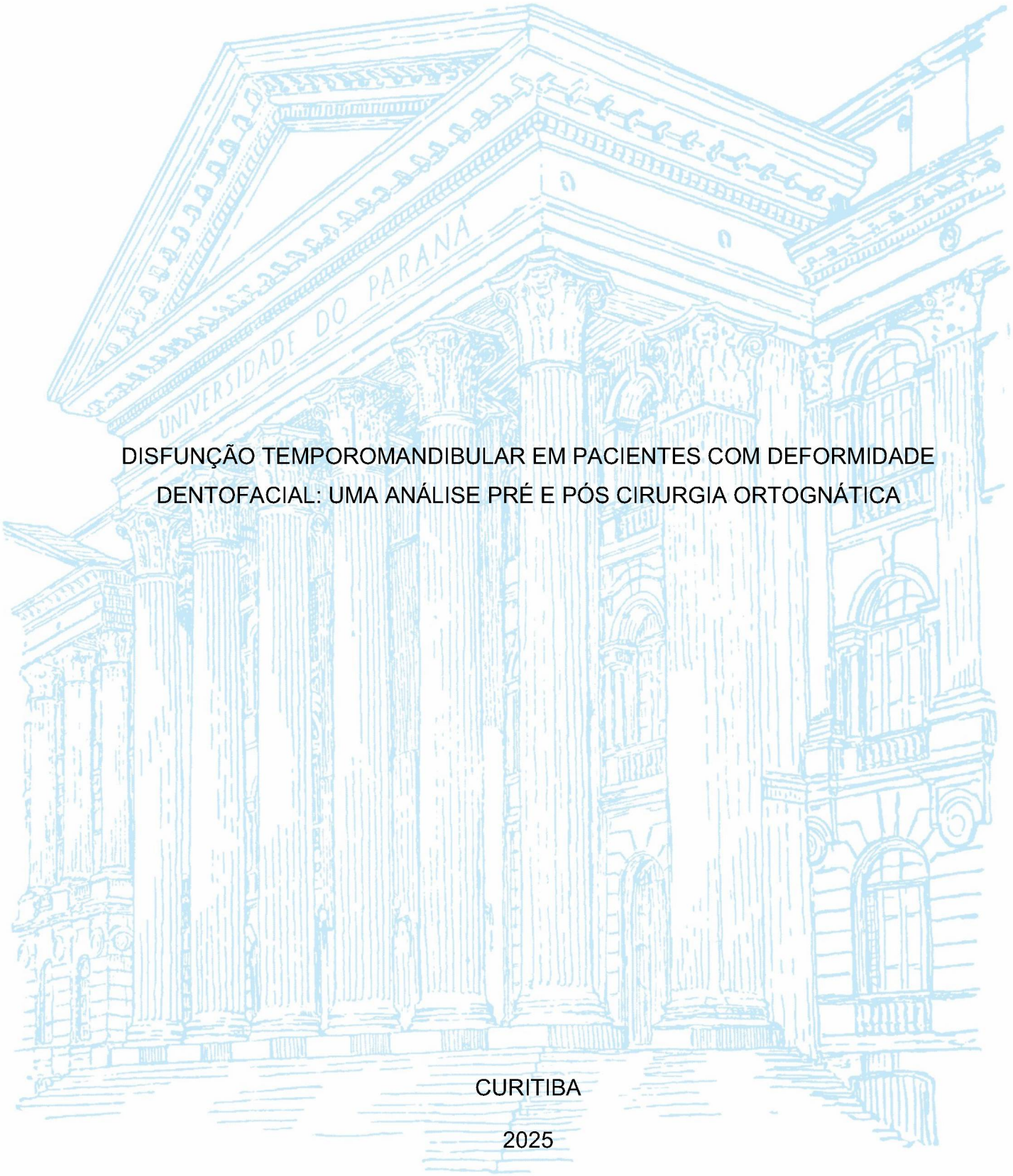

DISFUNÇÃO TEMPOROMANDIBULAR EM PACIENTES COM DEFORMIDADE DENTOFACIAL: UMA ANÁLISE PRÉ E PÓS CIRURGIA ORTOGNÁTICA

CURITIBA

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Tese apresentada ao Programa de Pós-graduação em Odontologia, Setor de Ciências da Saúde, Universidade Federal do Paraná, como requisito parcial à obtenção do título de Doutor emClínica Odontológica.

Orientadora: Prof. Dra. Rafaela Scariot
Coorientador: Prof. Dra. Aline Sebastiani

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TERMO DE APROVAÇÃO

Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação ODONTOLOGIA da Universidade Federal do Paraná foram convocados para realizar a arguição da tese de Doutorado de **DANIELLE MEDEIROS VEIGA BONOTTO**, intitulada: **DISFUNÇÃO TEMPOROMANDIBULAR EM PACIENTES COM DEFORMIDADE DENTOFACIAL: UMA ANÁLISE PRÉ E PÓS CIRURGIA ORTOGNÁTICA**, sob orientação da Profa. Dra. RAFAELA SCARIOT, que após terem inquirido a aluna e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

A outorga do título de doutora está sujeita à homologação pelo colegiado, ao atendimento de todas as indicações e correções solicitadas pela banca e ao pleno atendimento das demandas regimentais do Programa de Pós-Graduação.

CURITIBA, 29 de Julho de 2025.

RAFAELA SCARIOT
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(I Coríntios 13:2)

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RESUMO

Introdução: As disfunções temporomandibulares (DTM) compreendem um conjunto de sinais e sintomas que acometem a articulação temporomandibular (ATM) e os músculos associados, entre os quais a artralgia se destaca como uma das manifestações mais relevantes, especialmente no contexto da cirurgia ortognática (CO). A relação entre as deformidades dentofaciais (DDF) e a artralgia representa um desafio clínico significativo no planejamento cirúrgico, considerando sua etiologia multifatorial que envolve aspectos biomecânicos, psicossociais e neurofisiológicos. Objetivo: Identificar fatores associados à presença de artralgia pré-operatória em pacientes com DDF estratificados pela maloclusão esquelética II e III, bem como investigar fatores pré, trans e pós-operatórios relacionados à ocorrência de artralgia após a CO. Métodos: Este estudo observacional incluiu uma amostra transversal de 83 pacientes e uma coorte prospectiva acompanhada por 12 meses no pós-operatório. Foram utilizados instrumentos padronizados para avaliação clínica da DDF e das disfunções temporomandibulares (*Diagnostic Criteria for Temporomandibular Disorders* – DC/TMD), além de instrumentos psicossociais: *Generalized Anxiety Disorder-7* (GAD-7), *Patient Health Questionnaire-15* (PHQ-15), *Pittsburgh Sleep Quality Index* (PSQI) e *Oral Behavior Checklist* (OBC). Uma análise de *clusters* permitiu distinguir dois agrupamentos de indivíduos: aqueles com altos escores das variáveis: DTM muscular, ansiedade, qualidade de sono ruim, bruxismo em vigília e sintomas somáticos, classificados como *cluster vulnerável*, e aqueles com baixos escores, caracterizados como *cluster adaptável*. As análises estatísticas incluíram testes univariados (qui-quadrado, teste Exato de Fisher e o teste de McNemar para comparações pré e pós-operatórias) e análise de *clusters K-means*. Para os modelos de regressão foi utilizado a Regressão de Poisson multivariada com variância robusta. Resultados: Na avaliação transversal, observou-se que, entre pacientes Classe II, fatores como sexo feminino *(p= 0,039)* excesso vertical maxilar *(p= 0,014)* e presença de desordem intra-articular *(p= 0,012)* foram significativamente associados à artralgia. Nos pacientes Classe III, destacou-se a influência de características psicossociais e comportamentais agrupadas no *cluster* vulnerável *(p= 0,039)* [Artigo 1]. Sessenta e nove pacientes compuseram a amostra final do estudo de coorte prospectivo [Artigo 2]. Observou-se que a variável "dor além da região facial" (RP= 3,93 [1,38–11,18]; *p= 0,010*), "desordem intra-articular" (RP= 4,09 [1,02–16,76]; *p= 0,050*) e "bruxismo em vigília" (RP= 5,46 [1,07–27,83]; *p= 0,041*) permaneceram como preditores independentes de artralgia pós-operatória. Nenhuma variável transoperatória apresentou significância estatística *(p≥ 0,05)*. Após a cirurgia, observou-se uma redução significativa na prevalência de artralgia (34,8% para 14,5%; *p= 0,003*). Conclusão: Esses achados indicam que, embora fatores anatômicos tenham maior relevância em alguns perfis esqueléticos, no pré-operatório. Os mecanismos de sobrecarga funcional e sensibilização parecem exercer influência determinante sobre a manifestação e a manutenção da artralgia temporomandibular após a CO.

Palavras-chave: articulação temporomandibular; cirurgia ortognática; dor facial; artralgia; bruxismo; maloclusão.

ABSTRACT

Introduction: Temporomandibular disorders (TMD) comprise a set of signs and symptoms affecting the temporomandibular joint (TMJ) and the associated muscles, among which arthralgia stands out as one of the most relevant manifestations, especially in the context of orthognathic surgery (OS). The relationship between dentofacial deformities (DFD) and TMJ arthralgia represents a significant clinical challenge in surgical planning, considering its multifactorial etiology involving biomechanical, psychosocial, and neurophysiological aspects. Objective: To identify factors associated with the presence of preoperative arthralgia in patients with DFD, stratified by skeletal maloclussion II and III, and to investigate pre-, trans-, and postoperative factors related to the occurrence of arthralgia following OS. Methods: This observational study included a cross-sectional sample of 83 patients and a prospective cohort followed for 12 months postoperatively. Standardized instruments were used to assess DFD and temporomandibular disorders (*Diagnostic Criteria for Temporomandibular Disorders* – DC/TMD), as well as psychosocial aspects through the *Generalized Anxiety Disorder-7* (GAD-7), *Patient Health Questionnaire*-15 (PHQ-15), *Pittsburgh Sleep Quality Index* (PSQI), and *Oral Behavior Checklist* (OBC). A *cluster* analysis identified two groups: individuals with high scores for muscle TMD, anxiety, poor sleep quality, awake bruxism, and somatic symptoms, classified as the *vulnerable cluster*, and those with low scores, defined as the *adaptable cluster*. Statistical analyses included univariate tests (Chi-square, Fisher's exact test and McNemar's test for pre- and postoperative comparisons) and *K-means* cluster analysis, multivariate Poisson regression with robust variance. Results: In the cross-sectional assessment, among patients with skeletal Class II, morphological factors such as female sex ($p= 0.039$), maxillary vertical excess (p= *0.014*), and intra-articular disorder ($p= 0.012$) were significantly associated with arthralgia. In skeletal Class III, psychosocial and behavioral characteristics grouped in the vulnerable cluster ($p= 0.039$) were predominant. Sixty-nine patients comprised the final sample of the prospective cohort. In the multivariate model, pain beyond the facial region (PR = 3.93 [1.38–11.18]; $p= 0.010$), intra-articular disorder (PR = 4.09 [1.02–16.76]; $p= 0.050$), and awake bruxism (PR = 5.46 [1.07–27.83]; $p= 0.041$) remained as independent predictors of postoperative arthralgia. No transoperative variables reached statistical significance ($p \geq 0.05$). Following surgery, a significant reduction in the prevalence of arthralgia was observed (from 34.8% to 14.5%; $p= 0.003$). Conclusion: These findings indicate that although anatomical factors are more relevant in some skeletal malocclusion, functional overload and sensitization mechanisms appear to play a decisive role in the development and persistence of temporomandibular arthralgia after OS.

Keywords: temporomandibular joint disorders; orthognathic surgery; orofacial pain; arthralgia; bruxism; dentofacial deformities.

LISTA DE ABREVIATURAS

- **AB** – Awake Bruxism
- **ATM** – Articulação Temporomandibular
- **CO** – Cirurgia Ortognática
- **DAG** – Directed Acyclic Graph
- **DC/TMD** – Diagnostic Criteria for Temporomandibular Disorders
- **DDF** – Deformidade Dentofacial
- **DFD**- Dentofacial Deformity
- **DTM** – Disfunção Temporomandibular
- **FIE** – Fixação Interna Estável
- **GAD-7** – Generalized Anxiety Disorder – 7
- **ICF** – Informed Consent Form
- **OS** – Orthognathic Surgery
- **OSBRM** – Osteotomia Sagital Bilateral dos Ramos Mandibulares
- **OBC** – Oral Behavior Checklist
- **PHQ-15** – Patient Health Questionnaire – 15
- **PSQI** – Pittsburgh Sleep Quality Index
- **SB** – Sleep Bruxism
- **STROBE** – Strengthening the Reporting of Observational Studies in Epidemiology
- **TMD** – Temporomandibular Disorders

SUMÁRIO

1. INTRODUÇÃO E REVISÃO DA LITERATURA

Deformidades dentofaciais (DDF) são definidas como sérios problemas de maloclusão dentária associada a alterações esqueléticas que requerem um tratamento combinado entre ortodontia e cirurgia ortognática (CO) (FERRAZ *et al.*, 2011). Tais deformidades podem ser mínimas como uma leve projeção do mento, ou extremas, como um excesso maxilar vertical severo ou uma microssomia hemifacial. O acometimento pode estar presente em uma ou duas bases ósseas, nos planos vertical, horizontal e transversal, tanto de maneira isolada como combinada, acarretando diferentes tipos de deformidades. As principais DDF são: classe II esquelética, classe III esquelética, biprotrusão esquelética, mordida aberta anterior esquelética e mordida cruzada posterior bilateral esquelética (FISH *et al.*, 1993).

A relação entre DDF e disfunções temporomandibulares (DTM) tem sido alvo de debate científico há décadas. Inicialmente, a instabilidade oclusal e as discrepâncias esqueléticas foram consideradas fatores etiológicos centrais para a DTM (PULLINGER & SELIGMAN, 1991). Com os avanços na compreensão da dor orofacial, a teoria multifatorial passou a ser amplamente aceita, integrando fatores biomecânicos, psicossociais, genéticos e neurofisiológicos (SLADE *et al.*, 2013).

Entretanto, a literatura aponta um alto índice de sinais e sintomas de DTM nos indivíduos na fase de tratamento ortodôntico pré-cirúrgico quando comparado ao pós-cirúrgico (AL-MORAISSI, WOLFORD, *et al.*, 2017; SEBASTIANI *et al.*, 2018), porém alguns autores não atribuem essa melhora a correção da DDF (DERVIS & TUNCER, 2002). No entanto, os achados são inconsistentes quanto à associação entre o tipo de DDF e o risco para DTM, o que pode ser atribuído à heterogeneidade dos métodos diagnósticos, à ausência de grupos de comparação adequados e à falta de estratificação por maloclusão esquelética nos estudos (AL-MORAISSI, WOLFORD, *et al.*, 2017; SLADE *et al.*, 2013; MANFREDINI *et al.*, 2016; DERVIS & TUNCER, 2002; DE CLERCQ *et al.*, 1998).

1.1 Deformidades Dentofaciais

As DDF são descritas como uma condição em que o crescimento e desenvolvimento

do esqueleto facial se desviam do padrão normal e podem afetar de 5% a 20% da população de acordo com a etnia, trazendo prejuízo estético e funcional (WOLFORD LM, 1999). Sendo assim, os ossos da maxila e da mandíbula apresentam modificação na forma e tamanho podendo impactar na harmonia facial. Em termos de saúde bucal, as DDF frequentemente estão associadas a uma maloclusão, ou seja, uma relação desarmônica entre as arcadas dentárias. As DDF ainda impactam na estética facial dos pacientes nos planos frontal e lateral (perfil). Os perfis mais comuns em pacientes com DDF são os convexos e côncavos, observados nos Classe II e III, respectivamente. Além disso, na visualização frontal do rosto, podem ser identificadas assimetrias e desproporções entre os terços faciais devidos aos crescimentos anômalos de maxila e/ou mandíbula em direção transversal e vertical (SATO *et al.*, 2014; WOLFORD, 1999).

O desenvolvimento craniofacial é regulado por um controle genético modificado por fatores ambientais. Essa interação é complexa, e normalmente é impossível diferenciar precisamente essas influências (JUNG et al., 2013; YANG *et al.*, 2012). Traumas faciais também podem modificar o desenvolvimento do esqueleto (CHOI et al., 2005; OBWEGESER, 2007).

As DDF podem ser classificadas de diferentes formas, fundamentadas na análise oclusal, no exame clínico da face, avaliação radiográfica e cefalométrica (WOLFORD, 1999.). A face pode ser classificada em Classe I, II, III, face longa ou curta pela avaliação visual. São definidos pacientes Classe II quando há uma relação discrepante da arcada superior em relação à inferior. Pode se apresentar como um retrognatismo mandibular, um excesso no sentido anteroposterior da maxila ou uma combinação de ambos. Na deformidade do tipo Classe III, ocorre uma proeminência da arcada inferior, podendo resultar de deficiência anteroposterior da maxila ou prognatismo mandibular isolado, ou ainda uma combinação de ambos. Já nas anomalias do tipo Classe I, as arcadas dentárias estão corretamente alinhadas, mas os ossos maxilares apresentam tamanhos desproporcionais quanto a face do paciente ou assimetrias podem estar presentes (OBWEGESER, 2007; OBWEGESER, 1993).

1.2 Cirurgia Ortognática

A CO combinada ao tratamento ortodôntico é o tratamento mais previsível para as DDF moderadas a severas. Uma das técnicas mais utilizadas para este fim é a osteotomia sagital bilateral dos ramos mandibulares (OSBRM) estabelecida por TRAUNER &

OBWEGESER, 1957 e posteriormente modificada por DAL PONT, 1961. É a técnica cirúrgica mais utilizada para correção de deformidades da mandíbula pois permite o seu reposicionamento em vários sentidos. As suas indicações principais incluem a correção do excesso ou deficiência ântero-posterior de mandíbula e assimetrias (REYNEKE & FERRETTI, 2016). A versatilidade dessa técnica se deve ao fato de seu design oferecer uma ampla área de contato entre os segmentos ósseos, o que proporciona melhor cicatrização óssea e estabilidade, além de permitir a aplicação de fixação estável de forma precisa e adequada (REYNEKE & FERRETTI, 2016). No entanto, a técnica apresenta algumas desvantagens, como os distúrbios neurossensoriais da região inervada pelo nervo alveolar inferior. Além disso, existe a possibilidade de ser aplicado um efeito de torque aos côndilos, resultado da fixação interna estável (AL-MORAISSI & ELLIS, 2015).

O procedimento padrão para estabilização da OSRM é a fixação interna estável (FIE). Diferentes métodos de FIE podem ser empregados conforme a situação clínica e preferência do cirurgião. As principais variações das FIE são a utilização somente de parafusos bicorticais, placas com parafusos monocorticais ou a técnica híbrida, que combina placas com parafusos monocorticais e bicorticais (ESHGHPOUR *et al.*, 2023). A escolha do método de fixação na mandíbula pode representar fator de risco para a articulação temporomandibular (ATM). A literatura aponta que o risco de DTM pós-operatória pode estar relacionado ao uso de parafusos bicorticais, já que esses resultam em maior compressão dos segmentos ósseos (URETURK & APAYDIN, 2018; WESTERMARK *et al.*, 2001).

Para a correção do posicionamento maxilar a técnica de eleição, que surgiu na década de 70, é a osteotomia Le Fort I. Essa abordagem é caracterizada por uma secção horizontal, que se estende da abertura piriforme ao processo pterigoide da maxila bilateralmente. Descrita primeiramente em 1861, e consolidada biologicamente como acesso cirúrgico seguro com base nos estudos de microcirculação óssea publicados por Bell em 1975. Por meio dela, é possível a realização de movimentos nos 3 planos: transversal, sagital e vertical da maxila (MILORO, 2013). Além disso, permite realizar a segmentação da maxila para realização de movimentos em dois ou mais sentidos, em diferentes regiões do osso, no mesmo procedimento (MILORO, 2013; KAHNBERG & HAGBERG, 2007).

Pacientes que buscam a correção das DDF por meio de tratamento ortodôntico-cirúrgico frequentemente apresentam expectativas significativas quanto à melhoria dos sinais e sintomas da DTM após a cirurgia. A influência da CO sobre os sintomas de DTM

tem sido alvo de amplo debate entre cirurgiões bucomaxilofaciais e especialistas em DTM. Tal discussão gira em torno da possibilidade de melhora dos sintomas pela correção da deformidade, ao mesmo tempo em que se pondera a eventual manifestação de sintomas em pacientes sem DTM pré-operatória, em virtude da extensa manipulação óssea e muscular realizada durante a cirurgia. Embora o tema seja objeto de investigação há décadas, ainda persiste a falta de consenso na literatura, com resultados discrepantes justificados pela falta de padronização entre os estudos. Essa relação complexa pode ainda ser influenciado por diversos fatores, como o tipo da DDF, o subtipo da DTM e os movimentos cirúrgicos realizados, entre outros (AL-MORAISSI, WOLFORD, *et al.*, 2017).

1.3 Disfunção Temporomandibular

Segundo a Academia Americana de Dor Orofacial, a DTM é definida como um conjunto de distúrbios que envolvem os músculos mastigatórios, a ATM e estruturas associadas. A principal manifestação clínica é a dor, acompanhada de limitação e/ou não coordenação dos movimentos mandibulares e ruídos articulares. Impactando diretamente na qualidade de vida, já que atinge funções básicas como mastigação e fala. Estudos epidemiológicos estimam que 40% a 75% da população apresentem ao menos um sinal ou sintoma de DTM, como ruídos na ATM e 33% pelo menos um sintoma, como dor na face ou na ATM (DE LEEUW, 2013). No Brasil estima-se que 37,5% da população apresente ao menos um sintoma de DTM (GONÇALVES *et al.*, 2009).

O método de classificação mais aceito atualmente é o *Diagnostic Criteria for Temporomandibular Disorders* (DC/TMD) que representou uma evolução notável na compreensão e abordagem das DTM (SCHIFFMAN *et al.*, 2014). No contexto histórico, as DTM foram frequentemente subestimadas ou mal interpretadas, resultando em diagnósticos imprecisos e tratamentos inadequados (DE LEEUW, 2013) . Antes da introdução do DC/TMD, a falta de critérios diagnósticos padronizados contribuiu para uma heterogeneidade nos estudos e na prática clínica. Havia uma urgência em estabelecer um sistema robusto e abrangente para o diagnóstico das DTM. O DC/TMD foi desenvolvido por uma colaboração internacional entre pesquisadores e clínicos, buscando criar uma estrutura diagnóstica baseada em evidências. Publicado em 2014, trouxe critérios bem definidos e diretrizes claras para diagnóstico das DTM, abordando não apenas a dor e

aspectos físicos avaliados pelo Eixo I, mas também outros aspectos funcionais e comportamentais associados, investigados pelo Eixo 2 (SCHIFFMAN *et al.*, 2014).

O Eixo I é composto por três ferramentas: triagem de dor em DTM, questionário de sintomas e exame físico de DTM. Para o diagnostico das DTM, os procedimentos do DC/TMD envolvem os preenchimentos do questionário de sinais e sintomas e a realização de um exame físico que inclui palpação muscular e articular calibradas e observação da função mandibular. Com base nos resultados obtidos e com o auxílio de um fluxograma de diagnóstico, a ferramenta identifica duas categorias principais: condições dolorosas e desordens das ATM. As condições dolorosas são classificadas como mialgia, mialgia local, dor miofascial com espalhamento, dor miofascial com referência, artralgia e cefaleia atribuída à DTM. Em relação aos distúrbios da ATM, e classificados como: deslocamento de disco com redução, deslocamento de disco com redução e travamento intermitente, deslocamento de disco sem redução e sem limitação da abertura, deslocamento de disco sem redução e com limitação da abertura e doença articular degenerativa (SCHIFFMAN *et al.*, 2014).

Muito se avançou no entendimento da etiologia das DTM nos últimos anos. Atualmente, o modelo biopsicossocial é o mais aceito, onde uma combinação de fatores biológicos, psicológicos e sociais, todos transcritos por a componentes genéticos explicariam o desenvolvimento das DTM. A sobrecarga oclusal e hábitos parafuncionais são frequentemente citados como fatores biomecânicos; aumento dos níveis de hormônios de estrogênio são considerados fatores biológicos e entre os fatores biopsicossociais destaca-se o estresse, ansiedade ou depressão (SLADE *et al.*, 2013). Esses itens são investigados por meio de questionários validados que compõe o Eixo 2 de avaliação do DC/TMD.

Com a melhora na compreensão dos fatores de risco e etiologia, somado a um método de diagnóstico mais assertivo as opções de tratamento para DTM se expandiram e se aperfeiçoaram ao longo dos anos. As modalidades mais conservadoras, como aparelhos interoclusais, exercícios fisioterápicos e orientação comportamental ganharam força. As terapias minimamente invasivas, como infiltrações, ganharam respaldo na literatura e ampliaram suas indicações. Desta forma, as abordagens cirúrgicas para tratamento das DTM foram sendo restringidas para casos específicos, como quadros articulares refratários às terapias conservadoras, severas limitações e degenerações articulares (AL-MORAISSI *et al.*, 2022; AL-MORAISSI, FAREA, *et al.*, 2020; AL-MORAISSI, *et al.*, 2020).

1.4 Interface DDF e DTM

A relação entre DTM e a morfologia facial é investigada por meio da comparação de sinais de anormalidades identificadas por exames de imagem, e pela relação de sinais e sintomas clínicos em indivíduos com distintas DDF. Esses estudos transversais não permitem identificar a ordem temporal das condições (ou seja, se a morfologia esquelética precede a DTM ou vice-versa) e se há uma relação causal entre ambas as condições (JUNG *et al.*, 2013; YANG *et al.*, 2012). Em termos teóricos, Manfredini considerou ambas as hipóteses como igualmente plausíveis (MANFREDINI *et al.*, 2016). Por exemplo, a possibilidade de um papel etiológico do desarranjo interno da ATM no desenvolvimento atípico do esqueleto facial, fundamentando-se na ideia de que o côndilo desempenha um papel crucial no crescimento do esqueleto craniofacial (SAKAR *et al.*, 2013). Por outro lado, é plausível que uma deformidade esquelética, seja geneticamente determinada ou adquirida, possa contribuir para a manifestação de alguns distúrbios na ATM, aumentando a suscetibilidade a micro ou macrotraumas no sistema articular (KRISJANE *et al.*, 2012; UEKI *et al.*, 2008; GIDARAKOU *ET AL.*, 2003).

Nesse contexto, das DDF como facilitador para a manifestação das DTM, a discussão na literatura é ampla e com diversas lacunas. Alguns trabalhos reportaram uma maior prevalência de DTM em pacientes com DDF, porém os sub-diagnósticos das DTM e quais os tipos da DDF muitas vezes não são descritos, e a ausência de grupos adequados de comparação limitam a aplicabilidade dos resultados (AL-MORAISSI *et al.*, 2017).

Apesar dos vieses metodológicos, alguns pesquisadores sugerem que o ramo curto e a altura facial posterior, bem como a posição para trás e a rotação da mandíbula seriam características associadas ao deslocamento do disco da ATM. Essas características são comuns aos padrões de crescimento esquelético de Classe II e/ou hiperdivergente. As mesmas características esqueléticas também se relacionaram positivamente com a progressão da doença articular degenerativa ou sinais e sintomas de DTM em adultos (MANFREDINI *et al.*, 2016). Por outro lado, pacientes com classe esquelética III e padrão hipodivergente podem estar menos predispostos ao deslocamento do disco da ATM, devido à sua vantagem biomecânica (FERRARIO *et al.*, 1999).

É importante ressaltar que os estudos carecem de qualquer informação sobre outros fatores de risco potenciais para DTM e são baseados em um desenho de fator único (ou seja, morfologia facial versus distúrbios da ATM, não levando em consideração a complexidade dos modelos biológicos (MANFREDINI *et al.*, 2016). Dessa maneira, a

ausência de dados sobre atividades de bruxismo, características psicológicas, comorbidades e qualidade do sono comprometem, até o momento, o entendimento sobre essa relação.

1.5 Artralgia em pacientes com DDF que serão Submetidos a Cirurgia Ortognática

Na ATM os diferentes padrões de crescimento esquelético podem impactar na distribuição das cargas funcionais resultando em implicações clínicas variadas, dependentes da adaptabilidade de cada paciente. Notavelmente, as DDF caracterizadas por grandes alterações de crescimento esquelético, parecem exigir uma capacidade adaptativa mais pronunciada dos seus hospedeiros (UEKI *et al.*, 2008). Destaque para a artralgia, um achado frequente em pacientes com DDF em busca de CO quando comparados a controles sem deformidades (MIOTTO *et al.*, 2023). Apesar da relação de casualidade não estar definida em razão de problemas metodológicas, há indícios na literatura que indivíduos com classe II esquelética e padrões faciais hiperdivergentes são mais propensos a distúrbios da ATM. A hipótese para esse achado remete a articulações desses pacientes serem caracterizadas por um mau ajuste das superfícies articulares, ou seja, côndilo pequeno e fossa articular larga, e estão potencialmente em risco de desenvolver anormalidades na posição do disco devido a instabilidade articular (MANFREDINI *et al.*, 2016).

O DC/TMD define a artralgia como dor na região da ATM reportada pelo paciente durante a função ou parafunção, e reconhecida durante testes de palpação calibrada ou manipulação funcional (SCHIFFMAN *et al.*, 2014). A fisiopatologia da artralgia da ATM é complexa e multifatorial, indo além de desarranjos internos da ATM, como os deslocamentos de disco, processos inflamatórios e degenerativos. O avanço no entendimento dos processos dolorosos tem contribuído para o entendimento da fisiopatologia das artralgias e consequentemente para o desenvolvimento de terapias mais abrangentes, incorporando abordagens multimodais e aspectos psicossociais (AL-MORAISSI *et al.*, 2020).

Dentre as terapias conservadoras destaca-se o emprego do dispositivo interoclusal rígido (DIO) com indicação para controle de sobrecargas articular e contribuindo para

melhora da lubrificação e formação de "pseudo-disco" em casos de deslocamento de disco articular (AL-MORAISSI, FAREA *et al.*, 2020; AL-MORAISSI, WOLFORD *et al.*, 2020). O DIO dificilmente é indicado para os pacientes em preparo ortodôntico para CO, já que os braquetes dificultam os ajustes da placa e requer interrupção das movimentações ortodônticas.

Contudo, ao avaliar os diversos fatores que compõem a etiologia multifatorial da artralgia, torna-se imperativo investigar e abordar outros aspectos e fatores de risco. Essa abordagem, que transcende as intervenções periféricas, representa uma mudança de paradigma para muitos cirurgiões, mas simultaneamente abre portas para abordagens conservadoras mais eficazes. Nesse contexto, a identificação de fatores de risco para artralgias e aprimoramento do seu manejo no pré, trans e pós-operatório se revelam prioritários (AL-MORAISSI, WOLFORD, *et al.*, 2020).

Além disso, compreender a relação entre um tipo específico de DDF e seus desfechos articulares têm sido objeto de discussões científicas, incluindo o papel desempenhado pela CO nesse contexto (WOLFORD *et al.*, 2003). Este entendimento mais aprofundado por estudos longitudinais não apenas contribui para avanços na prática clínica, mas também sinaliza a necessidade de uma abordagem personalizada no tratamento das DDF e suas implicações articulares.

1.6 Fenotipagem DTM e DDF

Atualmente, o diagnóstico das DTM baseia-se principalmente na presença de sintomas dolorosos na região orofacial, com métodos de classificação fundamentados na localização anatômica da dor (SCHIFFMAN *et al.*, 2014). Entretanto, embora fatores de risco diversos já tenham sido reconhecidos, como características psicológicas e processos de regulação neurossensorial, estes ainda não foram incorporados aos sistemas de subclassificação das DTM (SLADE *et al.*, 2013).

Nesse cenário, a aplicação de métodos de agrupamento por *cluster* desponta como uma abordagem promissora para caracterizar de forma mais abrangente os diferentes perfis clínicos de pacientes com DTM. Quando utilizada em populações com DDF, essa

estratégia possibilita identificar subgrupos específicos, associando variáveis psicossociais, comportamentais e morfológicas às manifestações dolorosas e funcionais. A partir dessa estratificação, podem ser delineadas intervenções terapêuticas personalizadas, considerando a heterogeneidade dos fatores etiológicos envolvidos (GAYNOR *et al.*, 2021).

Neste contexto, a metodologia de análise de *cluster* foi empregada no primeiro artigo que compõe esta tese, publicado por BONOTTO *et al.* 2024. No referido estudo, pacientes com DDF candidatos à CO foram avaliados por meio da técnica de agrupamento *K-means.* Dessa forma, foi possível identificar dois fenótipos clínicos distintos: o *cluster "Vulnerável"*, com alta prevalência de DTM muscular, sintomas de ansiedade, somatização, bruxismo em vigília e má qualidade do sono; e o *cluster "Adaptativo"*, caracterizado pela menor expressão desses fatores.

Essa abordagem ampliou a aplicabilidade dos achados de estudos relevantes, como o projeto OPPERA, às populações com DDF, evidenciando que fatores psicossociais e comportamentais podem exercer um papel determinante na manifestação das DTM, independentemente de alterações morfofuncionais. A fenotipagem baseada em *clusters* constitui, assim, uma ferramenta potencialmente útil na prática clínica, permitindo identificar pacientes com maior risco e orientar estratégias multidisciplinares no período pré-cirúrgico. Além disso, contribui para o avanço do modelo biopsicossocial na compreensão das DTM e na personalização do manejo em CO.

2. OBJETIVO DA PESQUISA

Identificar os fatores associados à presença de artralgia pré-operatória em pacientes com DDF estratificados por maloclusão esquelética II e III, bem como investigar fatores pré, trans e pós-operatórios relacionados à ocorrência de artralgia após a CO.

2.1 Objetivo do Artigo 1:

Identificar os fatores anatômicos, clínicos e psicossociais que estão associados à artralgia temporomandibular em pacientes com maloclusão esquelética Classe II e III no pré-operatório da CO.

2.2 Objetivo do Artigo 2:

Identificar fatores pré, trans e pós-operatórios associados à presença de artralgia temporomandibular após a CO em pacientes com DDF.

3. JUSTIFICATIVA DA PESQUISA

Representação conceitual da Artralgia em pacientes com DDF por *Directed Acyclic Graph* (DAG)

Diante da complexidade etiológica que envolve a artralgia temporomandibular em pacientes com DDF submetidos à CO torna-se importante fundamentar a escolha das variáveis analisadas em modelos conceituais robustos. Com esse propósito, esta pesquisa utilizou um *Directed Acyclic Graph* (DAG) como ferramenta teórica de representação das interações entre fatores anatômicos, clínicos, comportamentais e psicossociais potencialmente associados ao desfecho de artralgia temporomandibular. Essa ferramenta permitiu a sistematização das inter-relações entre fatores demográficos, morfofuncionais, comportamentais e psicossociais, orientando a escolha das variáveis e dos conjuntos de ajuste (AKINKUGBE *et al.*, 2016). A construção e o refinamento deste DAG foram realizados utilizando a plataforma *online* DAGitty (www.dagitty.net), uma ferramenta reconhecida e utilizada na pesquisa epidemiológica e em áreas correlatas da saúde, garantindo a reprodutibilidade e a transparência do modelo causal proposto.

As variáveis foram selecionadas com base em seu papel potencial como exposição, desfecho, ou como fatores que influenciam a relação entre eles, conforme evidências da literatura científica. As categorias são:

• Demográficas: sexo e idade;

•Comportamentais e Psicossociais: qualidade do sono ruim, ansiedade, somatização;

• Sobrecarga: bruxismo do sono e bruxismo em vigília;

• Sítios dolorosos: dor na face (artralgia e mialgia) e dor além da face;

• Morfofuncionais: perfil esquelético II, excesso vertical maxila, deslocamento de disco;

• Cirúrgicas: rotação anti-horária, fixação bicortical, avanço mandibular;

As setas no DAG indicam as relações causais hipotetizadas entre as variáveis, baseadas nas evidências da literatura científica. Uma seta de A para B (A -> B) significa que A possui relação direta com B. A ausência de uma seta entre duas variáveis implica que não há uma relação causal direta entre elas, dadas as outras variáveis no modelo. O DAG completo pode ser visualizado na plataforma www.dagitty.net através do código no Apêndice 3.

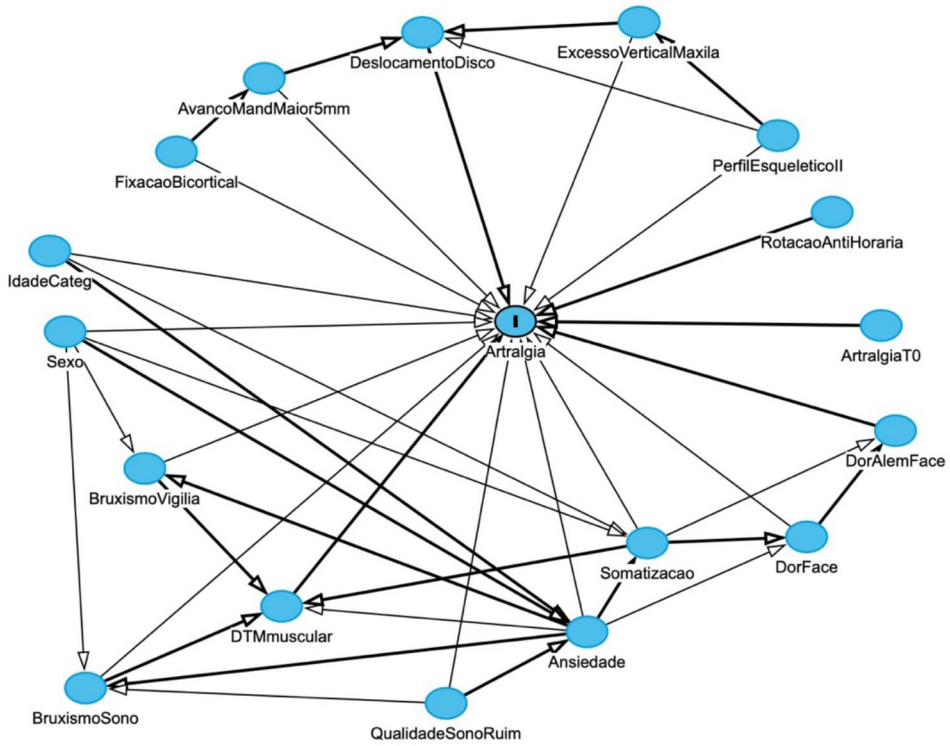

Figura 1- Directed Acyclic Graph (DAG) demonstrando a complexa etiologia da artralgia temporormandibular em pacientes com DDF submetidos a CO.

4. ARTIGO 1

FACTORS ASSOCIATED WITH ARTHRALGIA IN THE PREOPERATIVE PHASE OF ORTHOGNATHIC SURGERY: STRATIFIED ANALYSIS BY SKELETAL MALOCCLUSION

Abstract

Objective: To identify factors associated with temporomandibular joint (TMJ) arthralgia in patients with dentofacial deformity (DFD) undergoing orthognathic surgery (OS), stratified by skeletal malocclusion.

Method: Cross-sectional study including 83 patients evaluated up to two months before OS. The outcome presence of arthralgia was diagnosed using *Diagnostic Criteria for Temporomandibular Disorders* (DC/TMD). Independent variables comprised sex, age, skeletal malocclusion, maxillary vertical excess, intra-articular disorder, and a cluster grouping with high and low prevalence of etiological factors related to TMD: vulnerable or adaptable. Univariate analyses (chi-square/Fisher's exact test) and multiple Poisson regression models with robust variance were conducted, stratified by skeletal Class II and III.

Results: The overall prevalence of arthralgia was 41%. Among patients with skeletal Class II, arthralgia was significantly associated with female sex (PR = 4.9; [1.1–22.4] *p= 0.039*), presence of maxillary vertical excess (PR = 2.3; [1.2–4.5]; *p= 0.014*), and intra-articular disorder (PR = 2.5; [1.2–5.1] *p= 0.0.12*). In individuals with Class III, the only factor significantly associated with arthralgia was belonging to the vulnerable cluster. (PR = 2.6; [1.1–6.6]; *p= 0.039*).

Conclusion: In patients with skeletal Class II, TMJ arthralgia was related to female sex and morphological features. Among those with Class III, joint pain was primarily associated with psychosocial, behavioral characteristics and muscle TMD included in the vulnerable cluster.

Keywords: Keywords: Temporomandibular Joint Disorders; Orofacial Pain; Arthralgia; Bruxism; Dentofacial Deformities.

INTRODUCTION

Temporomandibular joint (TMJ) arthralgia is a critical factor in the preoperative planning of orthognathic surgery (OS), as it may predispose patients to a range of postoperative complications. During this period, the joint must accommodate new functional demands and demonstrate considerable adaptive capacity (1,2). Potential complications include prolonged postoperative pain, reduced adherence to or effectiveness of physiotherapy protocols, delayed functional recovery, and, over time, an increased risk of persistent facial pain and degenerative changes (3).

The management of arthralgia in the surgical preparation phase presents considerable challenges, especially due to the presence of orthodontic appliances and tooth movement, which restrict the use of interocclusal devices for controlling joint overload. Furthermore, the diagnostic accuracy of complementary examinations, such as magnetic resonance imaging (MRI), is frequently impaired by interference from metallic components, compromising detailed evaluation of the joint condition and hindering precise identification of TMJ structural alterations (3).

Arthralgia is highly prevalent in patients with dentofacial deformity (DFD) compared to individuals without the deformity (4-6). The literature attributes these findings to the greater adaptive demand of individuals with DFD, given that different growth patterns can influence the distribution of functional loads on the TMJ and disc positioning (7,8). This process results in varied clinical implications, determined by the individual physiological tolerance of each patient (9-11).

Although current etiological models of temporomandibular disorders (TMD) attribute limited importance to dental occlusion, evidence suggests that individuals with skeletal Class II and hyperdivergent facial patterns are more prone to TMJ disorders, including disc displacement and degenerative changes. Conversely, patients with skeletal Class III and hypodivergent patterns appear to have a lower predisposition to intra-articular disorder due to biomechanical advantages (9,10).

However, the main investigations on potential risk factors for TMD in patients with DFD are based on a single-factor design (i.e., facial morphology versus TMJ disorders), not taking into account the complexity of biological models, psychological characteristics, and overload (6,10). Consequently, the belief still persists among many surgeons that correction of skeletal discrepancies through OS is sufficient to effectively resolve signs and symptoms related to the TMJ. Furthermore, it is common to indicate concomitant surgical procedures

on the TMJ during OS, aiming at arthralgia relief — a conduct that, although properly indicated in specific cases, has been subject to overindication and remains a topic of considerable debate in the literature and clinical practice (1,12).

Thus, the presence of TMJ arthralgia in OS candidates represents a critical factor for surgical planning and for defining the most appropriate timing of intervention (1). Understanding the anatomical, clinical, and psychosocial factors associated with arthralgia in the preoperative period can contribute to outlining safer therapeutic strategies in the pre, trans, and postoperative phases, minimizing the risk of pain aggravation, joint dysfunction, and degenerative changes (1,13).

Therefore, the objective of this study was to identify which anatomical, clinical, and psychosocial factors would be associated with arthralgia in patients with DFD Class II and III in the preoperative period of OS.

MATERIALS AND METHODS

Study design, sample, and ethical aspects

This is an observational cross-sectional study conducted with all eligible individuals in preoperative preparation for OS, treated at the facilities of the Oral and Maxillofacial Surgery and Traumatology Service of the Federal University of Paraná (UFPR), in Curitiba, Southern Brazil. Data collection occurred over 12 months, between February 2022 and February 2023, thus characterizing a census study.

Sample size calculation was performed using the online platform OpenEpi® (www.openepi.com), considering a finite population of 96 patients (8 monthly surgeries over 12 months), a 95% confidence level, a 5% margin of error, and an expected prevalence of preoperative arthralgia of 45% (5). The minimum estimated sample size was 77 participants. To account for potential losses an additional 10% was incorporated. A total of 83 patients were included. This strategy ensured adequate statistical power for bivariate comparisons and multivariate modeling.

The study was conducted according to STROBE *(Strengthening the Reporting of Observational Studies in Epidemiology)* guidelines, ensuring methodological rigor and transparency in data presentation. Approval was obtained from the UFPR Research Ethics Committee under protocol CAAE: 52207821.9.0000.0102, in compliance with the Declaration of Helsinki. All participants were invited to join the study voluntarily and received

detailed information about its objectives and justifications through the Informed Consent Form (ICF) (14).

Participants were recruited up to two months prior to OS. Inclusion criteria encompassed patients in the preoperative phase of OS with sagittal skeletal discrepancies (skeletal Class II or III), aged over 18 years, without cleft lip, palate or associated syndromes. Exclusion criteria included inability to understand Portuguese, history of previous surgeries in the cervicofacial region, and cognitive or neurological conditions severe enough to impair comprehension of questionnaires or participation in the physical examination.

An initial pilot investigation was conducted to validate the study methodology and assess the adequacy of the questionnaires, involving 10 patients with DFD who met the same inclusion and exclusion criteria. The examiners (DVB, LC, AVM) were trained and calibrated in the application of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), with calibration reliability verified using the *kappa coefficient* (k = 0.95; 95% CI). The pilot study proceeded without complications, and upon its completion, the methodology was implemented in the main study, with these participants incorporated into the final sample.

Data collection

Demographic variables (sex and age), as well as information about medication use and the presence of comorbidities such as fibromyalgia, arthritis/arthrosis, and gastroesophageal reflux, were collected through self-report.

Dentofacial Deformities

An experienced surgeon (LC) evaluated the skeletal malocclusion of participants, classifying Class as II or III. Class II was characterized by a negative step between the maxilla and mandible, indicative of mandibular retrognathism. In contrast, Class III presented a positive step between the maxilla and mandible, suggesting anteroposterior maxillary deficiency, mandibular prognathism, or a combination of both (15). Additionally, patients were evaluated for vertical facial patterns, assymetry (midline deviation greater than 4mm) and maxillary vertical excess.

Maxillary vertical excess was defined clinically by superior gingival exposure greater than 4 mm on smiling, associated with hyperdivergent pattern on lateral facial examination (15).

Arthralgia

The diagnosis of arthralgia was established according to DC/TMD (16). Arthralgia was considered present when there was a report of pain in the region of any of the TMJs reported by the patient during function or parafunction, and recognized during calibrated palpation tests or functional manipulation as familiar pain.

Intra-Articular Disorders

In the present study, intra-articular disorder was investigated following the guidelines for clinical evaluation suggested by DC/TMD (16). Complementary examinations such as MRI were not employed in this study.

Clustering

This article employed the methodology described in a preliminary study that classified patients into clusters with high and low prevalence of etiological factors related to TMD (17). Based on the analysis of psychosocial variables, oral behaviors, sleep quality, and TMD diagnosis, two distinct phenotypic profiles emerged within this population: (1) a *"Vulnerable" cluster*, characterized by high levels of these factors, and (2) an "*Adaptable" profile*, in which these factors were absent or only minimally expressed.

The variables that proved effective for the formation of these clusters were the following according to order of importance and the instrument applied for the assessment: myalgia (DC/TMD) (16), somatization (*Patient Health Questionnaire*-PHQ-15) (18), anxiety (*Generalized Anxiety Disorder*- GAD-7) (19), subjective sleep quality (*Pittsburgh Sleep Quality Index*) [20], and awake bruxism (*Oral Behavior Checklist*-OBC) (21). The questionnaires and physical evaluation used compose the DC/TMD (16). Complementary reading of the referred article is suggested (17). (Appendix-5)

Sleep Bruxism

Sleep bruxism (SB) was assessed using both a self-reported questionnaire and a clinical examination, considering the preceding 30 days. Self-reported SB was identified with the OBC (21) specifically question 1 addressing the frequency of nocturnal teeth grinding or clenching. To increase diagnostic specificity, the evaluation also included the presence of clinical signs and symptoms (22). Clinical indicators assessed during the physical examination included: hypertrophy of the masseter and temporal muscles, tongue indentations and/or linea alba on the buccal mucosa, damage to dental structures (fractures or wear), and reports of morning facial pain or fatigue. Muscle activity secondary to

neurological disorders was excluded through self-administered questionnaires. While current recommendations (23) suggest reporting each assessment method independently, in this study self-report and clinical findings were additionally combined to improve the specificity of the assessment (22).

Data analysis

The dependent variable arthralgia was categorized as (absent and present). The independent variables and their categorizations were: sex (female and male), age (according to median was dichotomized into 18 to 30 years and above 31 years); Skeletal Malocclusion (Class II and Class III); Asymmetry (absent and present); Maxillary vertical excess (absent and present); Intra-articular Disorder (absent and presence); clustering variable (vulnerable and adaptive) and sleep bruxism (negative or only positive report=absent and positive report + clinical finding=present).

Data were subjected to descriptive statistical analysis, a significance level of 0.05 was considered. Analyses were performed using *SPSS Statistics software* (SPSS for Windows, version 25.0, IBM Inc., Armonk, NY, USA). Initially, a univariate analysis was performed through the Chi-square and Fisher's exact test to determine associations between arthralgia and the independent variables of the total sample and Class II and III. From this individualized analysis of Class, variables that presented associations with $p<0.20$ were selected for incorporation into Multivariate Poisson Analysis with robust variance. Variables that presented better fit and remained significant ($p < 0.05$) after adjustment were maintained in the final model. The confidence interval adopted was 95%.

RESULTS

A total of 83 individuals composed the final sample. Of these, 45 (54.2%) were women and 38 (45.8%) were men. The mean age was 30 (±9.71) years. Only 10 individuals (12%) reported comorbidities. Regarding skeletal malocclusion, the sample was distributed into 56 (67.5%) participants with Class III and 27 (32.5%) with Class II. Twenty-two individuals (26.5%) presented asymmetry and 18 (21.7%) presented maxillary vertical excess. Thirty-four individuals (41%) presented arthralgia, uni- or bilateral, and intra-articular disorder was clinically identified in 36 (43.4%) participants.

Considering that skeletal malocclusion represent distinct morphofunctional conditions, subsequent analyses were stratified by Class II (Table 1) and Class III (Table 2).

In the multivariate analysis referring to Class II (Table 3), the variables female sex (PR=4.9; 95%CI:1.1–22.4; *p= 0.039*), intra-articular disorder (PR=2.5; 95%CI:1.2–5.1; *p=0.012)*, and maxillary vertical excess (PR=2.3; 95%CI:1.2–4.5; *p= 0.014*) remained significantly associated with the presence of arthralgia. On the other hand, in Class III, the only statistically significant variable was the clustering variable (PR=2.6; 95%CI:1.1–6.6; *p= 0.039*), where individuals classified as "vulnerable" presented more than double the chances of presenting arthralgia when compared to the "adaptable" group (Table 4). Figure 1 illustrates the distribution of arthralgia within the "vulnerable" and "adaptable" clusters among patients with Class III.

TABLE 1 - PRESENCE OF ARTHRALGIA ACCORDING TO DEMOGRAPHIC AND CLINICAL CHARACTERISTICS IN CLASS II INDIVIDUALS (N=27); CURITIBA, BRAZIL

Predictor		**Arthralgia Present n (%)**	**Arthralgia Absent n (%)**	**Total N (%)**	**P-value***
Sex	Female	10 (37.0)	7 (25.9)	17 (63)	0.107
	Male	2 (7.4)	8 (29.6)	10 (37)	
Age	18 to 30 years	7 (25.9)	10 (37)	17 (63)	0.706
	31 years or more	5 (18.5)	5 (18.5)	10 (37)	
Asymmetry	Present	2 (7.4)	1 (3.7)	3 (11.1)	0.569
	Absent	10 (37)	14 (51.9)	24 (88.9)	
Maxillary Vertical Excess	Yes	8 (29.6)	4 (14.8)	12 (44.4)	0.057
	No	4 (14.8)	11 (40.7)	15 (55.6)	
Intra-articular Disorder	Yes	9 (33.3)	3 (11.1)	12 (44.4)	**<0.005**
	No	3 (11.1)	12 (44.4)	15 (55.6)	
Clustering	Vulnerable	7 (29.2)	3 (12.5)	10 (41.7)	0.095
	Adaptable	4 (16.7)	10 (41.7)	14 (58.3)	
Sleep Bruxism	Present	7 (25.5)	11 (40.7)	18 (66.7)	0.448
	Absent	5 (18.5)	4 (14.8)	9 (33.3)	

*Fisher's Exact Test.
Significant results at 5% level are in bold.
Values less than n=27 represent outliers of the cluster variable or incomplete data.

TABLE 2 - PRESENCE OF ARTHRALGIA ACCORDING TO DEMOGRAPHIC AND CLINICAL CHARACTERISTICS IN CLASS III PATIENTS (N=56); CURITIBA, BRAZIL

Predictor		**Arthralgia Present n (%)**	**Arthralgia Absent n (%)**	**Total n(%)**	**P-value**
Sex	Female	16 (28.6)	12 (21.4)	28 (50)	**<0.005***
	Male	6 (10.7)	22 (39.3)	28 (50)	
Age	18 to 30 years	9 (16.1)	20 (35.7)	29 (51.8)	0.190*
	31 years or more	13 (23.2)	14 (25)	27 (48.2)	
Asymmetry	Present	8 (14.8)	11 (20.4)	19 (35.2)	0.880*
	Absent	14 (25.9)	21 (38.9)	35 (64.8)	
Maxillary Vertical Excess	Yes	4 (7.1)	2 (3.6)	6 (10.7)	0.198**
	No	18 (32.1)	32 (57.1)	50 (89.3)	
Intra-articular disorder	Yes	11 (19.6)	13 (23.2)	24 (42.9)	0.385*
	No	11 (19.6)	21 (37.5)	32 (57.1)	
Clustering	Vulnerable	15 (28.3)	9 (17)	24 (45.3)	**<0.001***
	Adaptable	5 (9.4)	24 (45.3)	29 (54.7)	
Sleep Bruxism	Present	18 (32.7)	26 (47.3)	44 (80)	0.502**
	Absent	3 (5.5)	8 (14.5)	11 (20)	

*Chi-square test; **Fisher's Exact Test.
Significant results at 5% level are in bold.
Values less than n=56 represent outliers of the cluster variable or incomplete data.

TABLE 3 – MULTIVARIATE ANALYSIS BETWEEN ARTHRALGIA AND INDEPENDENT VARIABLES IN PATIENTS WITH SKELETAL CLASS II (N = 24†); CURITIBA, BRAZIL

Preditor		p-value	PRa	95% CI
Sex	Male	**0.039**	1	-
	Female		4.943	1.08 - 22.44
Clustering	Adaptable	0.065	1	-
	Vulnerable		1.765	0.966 - 3.22
Intra-articular disorder	Absent	**0.012**	1	-
	Present		2.491	1.22 - 5.08
Maxillary Vertical Excess	Absent	**0.014**	1	-
	Present		2.32	1.18 - 4.53

† Reduced N reflects missing data and cases excluded due to model non-convergence.
Multivariate Poisson Regression Model with robust variance
PRa = Adjusted Prevalence Ratio;
CI = Confidence Interval

TABLE 4– MULTIVARIATE ANALYSIS BETWEEN ARTHRALGIA AND INDEPENDENT VARIABLES IN PATIENTS WITH SKELETAL CLASS III (N = 49†); CURITIBA, BRAZIL

Preditor		p-value	PRa	95% CI
Sex	Male	0.056	1	-
	Female		2.310	0.97 - 5.45
Clustering	Adaptable	**0.039**	1	-
	Vulnerable		2.633	1.05 - 6.58
Maxillary Vertical Excess	Absent	0.370	1	-
	Present		1.387	0.67 - 2.83

† Reduced N reflects missing data and cases excluded due to model non-convergence.
Multivariate Poisson Regression Model with robust variance
PRa = Adjusted Prevalence Ratio;
CI = Confidence Interval

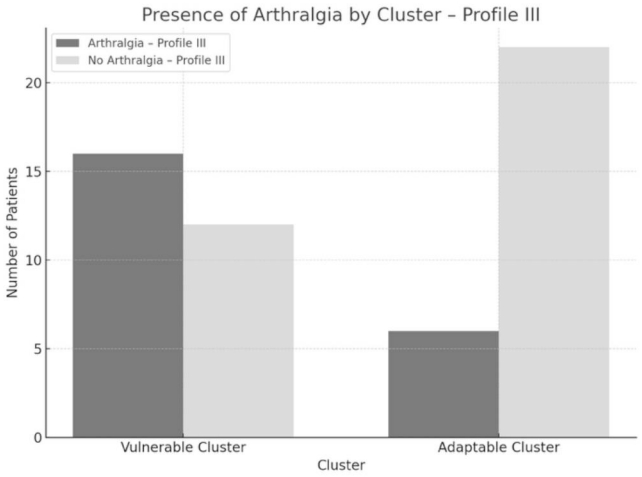

Figure 1 – Distribution of arthralgia in the "vulnerable" and "adaptable" clusters among patients with Class III.

DISCUSSION

This study investigated factors associated with TMJ arthralgia in patients with DFD undergoing OS, with analyses stratified by skeletal Class II and III malocclusions. The findings revealed a high prevalence of arthralgia in this sample, contrasting with rates around 10% typically reported in populations without DFD (5,6), and demonstrated that pain-related factors varied significantly according to the facial skeletal pattern.

Temporomandibular arthralgia is particularly relevant when planning and preparing patients for OS, and ideally, it should be addressed preoperatively to improve postoperative predictability (1,2). Recognizing this need, contemporary orthodontics and oral-maxillofacial surgery have increasingly incorporated concepts from other specialties, such as TMD and orofacial pain management, into clinical practice. However, the complexity inherent to biopsychosocial etiological models poses significant challenges for managing specific cases effectively. Historically, mechanistic concepts that directly linked occlusal alterations to TMD were deeply rooted in clinical practice, and remnants of this perspective still persist among some professionals(12). This mechanistic view often guides the indication of concomitant disc repositioning procedures during OS an approach that is increasingly questioned in the literature and has the potential to be overutilized. (24,25).

Among the factors associated with arthralgia identified in our study, the high prevalence among females stands out, a finding widely corroborated by previous research. Women have a recognized higher susceptibility to comorbidities, psychoemotional alterations, sleep disorders, and hormonal influences, all of which directly impact pain

amplification and nociceptive modulation mechanisms, thus increasing their predisposition to chronic TMD (26, 27). When stratified by facial skeletal malocclusion, female sex showed a strong association with arthralgia among patients Class II, especially when combined with morphological features such as vertical maxillary excess and intra-articular disorder. These findings align with previous studies demonstrating a greater prevalence of TMD in women with pronounced anteroposterior discrepancies (8,28). Conversely, in patients Class III, this association was not observed, suggesting that sex-related factors exert less influence on joint pain within this group. These results highlight the importance of stratifying patients by sex and skeletal malocclusion in surgical planning, thus enabling more individualized TMD management strategies. Notably, the low prevalence of comorbidities observed in our sample may be attributed to the characteristics of the studied population, primarily composed of young adults without significant primary pain complaints, whose main objective was undergoing OS.

In addition to female sex, psychological, behavioral, and sleep-related factors are widely recognized as highly relevant in pain manifestations (26,27,29). These dimensions had previously been investigated in samples of patients with DFD with noteworthy results, and the same stratification methodology was applied in this study (17). Using cluster analysis, we identified a subgroup called “Vulnerable,” characterized by a high prevalence of DC/TMD Axis I and Axis II components. To the Class III individuals, classified as “Vulnerable” in this cluster were twice as likely to present with arthralgia compared to those classified as “Adaptable”. However, to the class II individuals, clustering TMD classification had no significant influence. These findings reinforce the notion that, in Class III patients joint pain is predominantly influenced by sensitization mechanisms, overload and psychosocial factors rather than solely by morphofunctional characteristics. Conversely, in Class II patients, joint pain was strongly associated with structural factors such as intra-articular disorder, vertical maxillary excess, and female sex, highlighting the importance of morphofunctional assessment in this subgroup. Therefore, it is crucial to distinguish pain of structural origin—resulting from tissue alterations—from pain related to dysfunction in central processing, such as impaired nociceptive modulation and central facilitation. Nevertheless, influenced by a mechanistic model, many clinicians still tend to attribute pain exclusively to structural findings like disc displacement or degenerative changes. However, it is widely acknowledged that imaging examinations, although they often reveal significant alterations, have limited predictive value for pain within the biopsychosocial framework of TMD (29).

Our study suggests that biomechanical and structural findings may play a more relevant role in arthralgia outcomes among Class II patients. The complexity inherent to pain research, methodological limitations, and the multitude of etiological factors involved make this a challenging topic. Systematic reviews, such as that by Al-Moraissi *et al.*, 2017, indicate that patients with DFD have an increased risk (RR=1.63) of developing TMD compared to controls without DFD (6). It was noteworthy that risk factors differed significantly between skeletal malocclusion when assessed using multiple regression models. Although the existing literature remains inconclusive, there is evidence suggesting that Class II patients, especially those with hyperdivergent patterns, are at higher risk for articular TMD (7,8), while Class III patients are more susceptible to muscle disorders (9). This may be partly explained by biomechanical studies demonstrating that dolichofacial individuals experience greater TMJ loading during static biting compared to brachyfacial individuals (30). These findings underscore the importance of multidimensional assessment, integrating structural factors, pain modulation mechanisms, and psychosocial and behavioral aspects.

In this study, clinically assessed intra-articular disorder was highly prevalent and associated with arthralgia in both univariate and multivariate analyses, remaining a relevant factor among Clas II patients and reinforcing prior evidence (7,8). It is important to note that intra-articular disorder, especially when combined with limited mandibular opening and functional overload such as bruxism, is considered a risk factor for degenerative changes, justifying patient education and monitoring (31). Conversely, in Class III patients, intra-articular disorder showed no association with arthralgia, emphasizing the need to contextualize its interpretation as a risk factor. The literature consistently indicates that surgical approaches are rarely required to manage intra-articular disorder (32,33). However, these observations further highlight that psychosocial factors—such as somatization and anxiety—often exert a greater influence on pain manifestation than structural alterations per se in this group. Therefore, clinical management, especially for patients classified as "Vulnerable," should prioritize conservative treatments and coping strategies, avoiding invasive procedures based solely on morphological findings.

The strengths of this study include the use of validated instruments to address the complex phenomenon of pain, ensuring the collection of reliable and accurate data. Additionally, we applied cluster analyses described in previous research to comprehensively assess psychosocial factors and functional overload, a highly relevant but challenging domain to investigate. Future longitudinal studies with larger sample sizes and the use of

advanced imaging techniques are needed to confirm these associations and deepen our understanding of how these variables impact postoperative clinical and functional outcomes.

Stratifying patients according to the type of DFD emerged a a promising approach for identifying risk subgroups, allowing for more targeted interventions and safer surgical planning. These findings underscore the importance of a multidisciplinary preoperative assessment that integrates orthodontics, oral and maxillofacial surgery, and orofacial pain expertise. They also emphasize the need to incorporate assessments of psychoemotional status, sleep quality, and awake bruxism—elements comprising the "Vulnerable" cluster—into clinical evaluation and treatment planning for patients with DFD seeking OS, with the aim of optimizing outcomes and promoting comprehensive patient care.

CONCLUSION

We conclude that in patients with DDF, preoperative arthralgia is linked to different factors according to skeletal malocclusion. In Class II, female sex, maxillary vertical excess, and intra-articular disorder were significant predictors, underscoring the role of morphological characteristics in joint pain. Conversely, for patients with Class III, arthralgia was predominantly influenced by psychosocial factors clustered as "Vulnerable," including muscle TMD, anxiety, awake bruxism, somatization and impaired sleep quality, thus reinforcing the relevance of biopsychosocial mechanisms in this subgroup.

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5. ARTIGO 2

PREDICTIVE FACTORS FOR ARTHRALGIA AFTER ORTHOGNATHIC SURGERY IN PATIENTS WITH DENTOFACIAL DEFORMITIES: A PROSPECTIVE STUDY

Abstract

Objective: To investigate pre, trans, and postoperative factors associated with the presence of arthralgia after orthognathic surgery (OS) in patients with dentofacial deformities (DFD). Methods: This prospective study included 113 patients initially. The outcome presence of arthralgia was evaluated using *Diagnostic Criteria for Temporomandibular Disorders* (DC/TMD) before and after OS (12 months). The independent variables analyzed were: demographic data, anatomical features (skeletal profile, maxillary vertical excess, asymmetry), clinical parameters (preoperative arthralgia, intra-articular disorders, pain beyond the facial region, presence of awake and sleep bruxism), and surgical procedure-related factors (mandibular advancement and fixation, oclusal plane rotation). Pre-and postoperative comparisons were performed using McNemar's test. Identification of postoperative arthralgia predictors was conducted through univariate analyses (Fisher's exact test) and multivariate Poisson regression with robust variance. Results: Sixty-nine patients completed the study, with a median age of 28 years (18-61 years). The arthralgia prevalence reduced from 34.8% preoperatively to 14.5% postoperatively (*p= 0.003*). Preoperative "arthralgia" and "pain beyond the face," as well as postoperative "awake bruxism," "sleep bruxism," and "intra-articular disorder," were all associated with the outcome. In the multivariate model, "pain beyond the face" (PR= 3.93 [1.38-11.18] *p= 0.010*), "intra-articular disorder" (PR= 4.09 [1.02-16.76] *p= 0.050*), and "awake bruxism" (PR= 5.46 [1.07-27.83] *p= 0.041*) remained as independent predictors. No transoperative variables were associated with postoperative arthrlagia. Conclusion: The persistence or development of postoperative arthralgia was associated with preoperative presence of "pain beyond the face", and postoperative "awake bruxism" and "intra-articular disorders".

Keywords: Temporomandibular Joint Disorders; Orthognathic Surgery; Orofacial Pain; Arthralgia; Bruxism; Dentofacial Deformities.

INTRODUCTION

Postoperative arthralgia persists as a challenging outcome in patients undergoing orthognathic surgery (OS) for correction of dentofacial deformities (DFD), despite the general improvement in temporomandibular disorder (TMD) symptoms reported in part of the literature (1,2). For decades, it was widely assumed that skeletal discrepancies and occlusal instability were the main etiological factors underlying TMD (3). However, recent studies highlight that while OS may reduce TMD symptoms in symptomatic patients, a portion develops or maintains postoperative arthralgia, negatively impacting quality of life (1,4). This complexity is amplified by the multifactorial nature of arthralgia, which involves not only anatomical factors but also neurophysiological aspects, psychosocial factors, and parafunctional behavioral factors related to TMD (2).

Despite the growing number of studies on this topic, evidence regarding predictors of post-OS arthralgia remains inconclusive (1). The difficulty in determining these predictors in the literature is partly due to the lack of standardization in research methods and the influence of multiple factors that could interfere with postoperative outcomes (5-7). These factors range from the type of DFD, where patients with mandibular retrognathism present higher prevalence of articular disc displacements and degenerative disorders (2), to the surgical movements performed, type of fixation used, habits, and psychosocial condition after the procedure. Additionally, techniques such as bilateral sagittal split osteotomy of mandibular rami and Le Fort I osteotomy, although effective in correcting DFD, may introduce additional risks to the temporomandibular joint (TMJ), such as condylar overload and neurosensory resilience (8,9).

Thus, there is a need for longitudinal studies that integrate pre-, trans-, and postoperative variables in their analyses. In this context, prospective investigations that consider the interaction between morphofunctional characteristics, joint overload, and pain-related changes are essential to identify factors contributing to the persistence or emergence of articular pain after OS. Such evidence supports the development of preventive strategies and personalized management protocols. Therefore, the present study aimed to identify pre-, trans-, and postoperative factors associated with the presence of arthralgia after OS in patients with DFD.

METHODS

Study Design, Sample, and Ethical Aspects

This is a prospective cohort study conducted over 27 months (from February 2022 to May 2024). All patients with DFD undergoing orthodontic preparation for OS who sought care at the Oral and Maxillofacial Surgery and Traumatology Service (OMSTS) of the Department of Stomatology at the Federal University of Paraná (UFPR), located in Southern Brazil, were consecutively enrolled over a 15-month inclusion period and subsequently followed for 12 months. The study was approved by the Research Ethics Committee under protocol CAAE: 52207821.9.0000.0102 and adhered to all recommendations of the Declaration of Helsinki for research involving human subjects.

Participants were invited to participate in the study during a preoperative consultation scheduled within two months prior to OS, which was defined as the baseline assessment (T0). At this time, they received detailed information about the study objectives and rationale through the Informed Consent Form (ICF), and were informed about potential benefits and risks involved. The postoperative evaluation was conducted 12 months after surgery (T1). All participants were aware that their treatment would continue regardless of their decision to participate in the study and that they could withdraw at any time.

Inclusion criteria comprised patients over 18 years of age, of both sexes, in the preoperative period of OS, who presented sagittal alterations (skeletal Class II and III malocclusion), and who did not present cleft lip and palate or associated syndromes. Exclusion criteria were inability to understand Portuguese, presence of previous surgeries in the cervicofacial region, and severe cognitive and neurological conditions severe enough to impair comprehension of questionnaires or participation in the physical examination.

An initial sample size estimate was conducted based on data from the (OMSTS) at the UFPR. Considering an expected 14% change in arthralgia rates before and after surgery, calculated using McNemar's test, a significance level of 5%, and a statistical power of 80%, a minimum sample of 80 participants was estimated (https://www.medcalc.org/calc/sample-size-mcnemar-test.php). Accounting for a potential 20% loss to follow-up, the final target sample size was set at 100 participants.

Data Collection

Examiners were previously trained and calibrated for the application of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) tool, with calibration reliability confirmed by the *kappa coefficient* (k = 0.95; 95% CI). Demographic variables (sex and age), as

well as information about medication use and presence of comorbidities such as fibromyalgia, arthritis/arthrosis, and gastroesophageal reflux, were collected through self-report.

Dentofacial Deformities

An experienced surgeon evaluated participants' skeletal malocclusion, classifying them as Class II or Class III. Class II individuals were characterized by a negative step between maxilla and mandible, indicative of mandibular retrognathism. Those with Class III presented a positive step between maxilla and mandible, suggesting anteroposterior maxillary deficiency, mandibular prognathism, or a combination of both. Additionally, patients were evaluated for asymmetry (defined as midline deviation greater than 4mm) and maxillary vertical excess (defined as superior gingival exposure >4 mm on smiling combined with a hyperdivergent lateral facial pattern. (10).

TMD Assessment

For collection of clinical variables associated with TMD, the DC/TMD tools were used (11).

This questionnaire comprises initial questions regarding self-reported physical symptoms, including quality, location, and duration of pain. This tool addresses the frequency of facial pain, discomfort during mandibular movements, difficulties in wide mouth opening, fatigue/heaviness in the jaw, and joint sounds. Subsequently, a physical examination was performed, which included evaluation of masticatory muscles and TMJ during mandibular movements, in addition to calibrated palpation (pain location, familiarity, and reference pattern). Joint sounds (crepitation and clicking) and mouth opening patterns (deviations, deflections, or subluxation) were also evaluated.

Using the collected data and following a diagnostic flowchart, the tool allows the creation of two main diagnostic groups for painful conditions: articular pain and muscle pain (11).

Intra-articular disorders was investigated following the guidelines for clinical evaluation suggested by DC/TMD, without the use of complementary examinations such as magnetic resonance imaging (11).

Participants were evaluated for DC/TMD diagnosis at T-0 and T-1.

Bruxism

Self-reported Sleep Bruxism (SB) and Awake Bruxism (AB) were identified using the Oral Behaviour Checklist (OBC) (12), which assesses the frequency of oral and parafunctional behaviors reported by the patient. To enhance the specificity of the instrument, reported bruxism was combined with clinical signs and symptoms (13,14). During the physical examination, the following clinical indicators of bruxism were assessed: hypertrophy of the masseter and temporalis muscles, tongue indentations and/or linea alba on the inner cheek mucosa, damage to dental structures (such as fractures or wear), morning facial pain or fatigue (associated with sleep bruxism), and muscle or joint tenderness. Muscle activity secondary to other neurological disorders was ruled out through self-administered questions.

According to the most recent guidelines (15), both SB and AB were evaluated over the preceding 30 days. SB was assessed through subjective report of the frequency of teeth grinding or clenching during sleep (question 1 of the OBC) and also by clinical examination. Similarly, AB was evaluated based on the self-reported frequency of diurnal oral behaviors (questions 3 to 6 of the OBC) and by clinical assessment according to the signs described above. Although current recommendations describing each assessment mode separately, in this study, the combination of self-report and clinical findings was adopted as an additional category to improve diagnostic specificity. Participants were evaluated for SB and AB at T-0 and T-1.

Anxiety

The Generalized Anxiety Disorder Questionnaire (GAD-7) was used to screen for anxiety signs and symptoms. It includes seven items scored from 0 (“not at all”) to 3 (“nearly every day”), with total scores ranging from 0 to 21. Scores were classified as 5–9 (mild), 10–14 (moderate), and ≥15 (severe) anxiety.

Data Analysis

The dependent variable postoperative arthralgia was categorized into two groups: absent and present. Independent variables were:

- Demographic Variables: sex (male and female) and age (18 to 30 years and 31 years or more).
- Preoperative Variables: Class (II and III); maxillary vertical excess (absent and present); arthralgia (absent and present); intra-articular disorders (absent and present), pain beyond the face (absent and present).

- Transoperative Variables: mandibular surgery (absent and present), mandibular advancement (no advancement or ≤4.9 mm and ≥5 mm), clockwise rotation (absent and present); counterclockwise rotation (absent and present), fixation (monocortical and hybrid).
- Postoperative Variables: intra-articular disorders (absent and present), anxiety (moderate/severe and absent/mild), awake bruxism (negative report or only positive report = absent and positive report + clinical finding = present), sleep bruxism (negative or only positive report= absent and positive report + clinical finding = present).

After OS, individuals were classified into four groups according to arthralgia evolution: "arthralgia improvement," "arthralgia development," "arthralgia maintenance," and "no arthralgia."

Data were subjected to descriptive statistical analysis, with a significance level of 0.05 considered. Analyses were performed using *SPSS Statistics software* (SPSS for Windows, version 26.0, IBM Inc., Armonk, NY, USA). Initially, univariate analysis was performed through Fisher's exact test to determine associations between postoperative arthralgia and independent variables. From this analysis, variables that presented associations with $p<0.20$ were selected for incorporation into Multivariate Poisson Analysis with robust variance. Variables that presented better fit and remained significant ($p < 0.05$) after adjustment were maintained in the final model. Pre- and postoperative comparisons were performed using McNemar's test. The confidence interval adopted was 95%.

RESULTS

One hundred and thirteen participants were recruited for this study. Of these, 34 were excluded due to loss to follow-up and 10 due to the need for surgical reintervention resulting from pseudoarthrosis or other complications. A total of 69 participants comprised the final sample and were reevaluated 12 months after OS. Figure 1 demonstrates the sample composition through a flowchart.

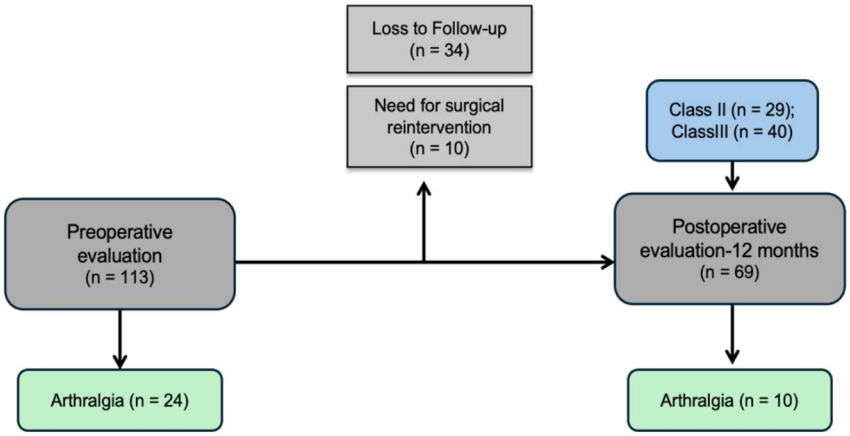

Figure 1 - Sample composition flowchart

The final sample consisted of 35 (50.7%) men and 34 (49.3%) women, with a median age of 28 years (18-61). Regarding skeletal malocclusion, the sample was distributed into 40 participants (58%) presenting Class III and 29 (42%) with Class II. Nineteen (27.5%) individuals presented asymmetry and 13 (18.8%) presented maxillary vertical excess.

A reduction in arthralgia prevalence was observed from 34.8% preoperatively (n = 24) to 14.5% (n = 10) after OS ($p= 0.003$). Similarly, myalgia was observed in 40.6% of participants preoperatively (n = 28) and decreased to 18.8% (n = 13) postoperatively ($p= 0.004$). Longitudinal analysis also indicated significant reductions in the occurrence of SB ($p= 0.035$) and AB ($p= 0.050$) after OS. Regarding joint noise, no statistically significant changes were identified between pre- and postoperative moments ($p= 0.851$).

The evolution of the sample after OS regarding postoperative arthralgia is presented in Figure 2, with only 3 patients (4.3%) developing arthralgia and 7 (10.1%) maintaining the condition after surgery.

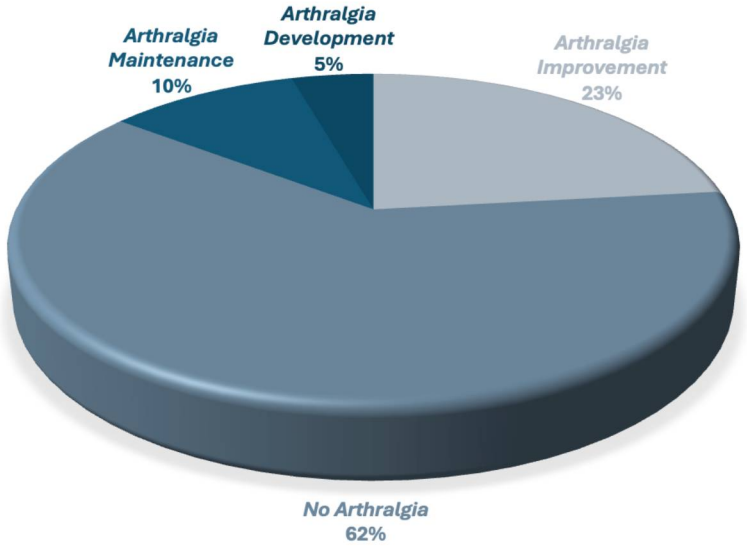

Figure 2 - Arthralgia evolution after Orthognathic Surgery

Among the patients who “developed arthralgia”, the group consisted exclusively by men. It is important to note that although these individuals developed an arthralgic condition, it was mild and did not impair masticatory function. Regarding transoperative variables, mandibular advancement exceeded 5 mm in only one case, and only one patient underwent mandibular asymmetry correction; none underwent occlusal plane rotation. Two patients presented a skeletal Class II, and monocortical fixation was used in all cases. All individuals developed intra-articular disorders after OS, which had been absent preoperatively. No significant findings were observed in psychoemotional parameters. Additionally, two of these patients exhibited both sleep and awake bruxism.

Regarding individuals who “maintained arthralgia”, the group was composed of 6 (85.7%) women and 1 (14.3%) man. Five (71.4%) participants were skeletal Class II and all required mandibular advancements greater than 5mm. Fixations were varied: 3 (42.9%) monocortical and 4 (57.1%) hybrid. In only one (14.3%) participant was clockwise rotation of the maxillomandibular complex performed. We highlight in this group the presence of preoperative myalgia in 5 (83.3%) participants and all presented postoperative myalgia. Six of them (85.7%) presented high somatic symptom indices, 4 (57.1%) moderate and severe anxiety symptoms preoperatively. All presented pain in other body parts beyond

the face preoperatively. Intra-articular disorder was present in 4 (57.1%) preoperatively and remained so postoperatively.

The statistical association between demographic, pre-, trans-, and postoperative predictors with the postoperative arthralgia outcome is shown in Table 1. Preoperative variables “arthralgia” and “pain beyond the face,” as well as postoperative “awake bruxism,” “sleep bruxism,” and “intra-articular disorder,” were all associated with the outcome.

TABLE 1. POSTOPERATIVE ARTHRALGIA ACCORDING TO PRE, TRANS AND POSTOPERATIVE PREDICTORS (N=69)

			POSTOPERATIVE ARTHRALGIA			
PREDICTORS			**Present n (%)**	**Absent n (%)**	**Total N (%)**	**P* value**
Demographic	Sex	Female	6 (8.7)	28 (40.6)	34 (49.3)	0.513
		Male	4 (5.8)	31 (44.9)	35 (50.7)	
	Age	18 a30 years	6 (8.7)	35 (50.7)	41 (59.4)	0.969
		31 years or more	4 (5.8)	24 (34.8)	28 (40.6)	
Preoperatative (T-0)	Class	II	7 (10.1)	22 (31.9)	29 (42)	0.082
		III	3 (4.3)	37 (53.6)	40 (58)	
	Maxillary Vertical Excess	Present	1 (1.4)	12 (17.4)	13 (18.8)	0.674
		Absent	9 (13.0)	47 (68.1)	56 (81.2)	
	Arthralgia	Present	7 (10.1)	17 (24.6)	24 (34.8)	**0.026**
		Absent	3 (4.3)	42 (60.9)	45 (65.2)	
	Intra-articular Disorder	Present	4 (5.8)	21 (30.4)	25 (36.2)	1.000
		Absent	6 (8.7)	38 (55.1)	44 (63.8)	
	Asymmetry	Present	3 (4.3)	16 (23.2)	19 (27.5)	0.850
		Absent	7 (10.1)	43 (62.3)	50 (72.5)	
	Pain beyond face	Present	8 (11.6)	22 (31.9)	30 (43.5)	**0.016**
		Absent	2 (2.9)	37 (53.6)	39 (56.5)	
Transoperative	Mandibular Surgery	Present	10 (14.5)	50 (72.5)	60 (87.0)	0.338
		Absent	0 (0)	9 (13.0)	9 (13.0)	
	Mandibular Advancement	≥5 mm	7 (14.3)	20 (40.8)	27 (55.1)	**0.012**
		No advancement or ≤4.9 mm	0 (0)	22 (44.9)	22 (44.9)	
	Clockwise Rotation	Present	1 (1.4)	4 (5.8)	5 (7.2)	0.512
		Absent	9 (13.0)	55 (79.7)	64 (92.8)	
	Counterclockwise Rotation	Present	1 (1.4)	18 (26.1)	19 (27.5)	0.555
		Absent	9 (13.0)	41 (59.4)	50 (72.5)	
	Fixation	Monocortical	6 (8.7)	36 (52.2)	42 (60.9)	1.00
		Hybrid	4 (5.8)	23 (33.3)	27 (39.1)	
Posoperative (T-1)	Intra-articular Disorder	Present	7 (10.1)	20 (29)	27 (39.1)	**0.041**
		Absent	3 (4.3)	39 (56.5)	42 (60.9)	
	Anxiety	Moderate/ Severe	2 (4.1)	8 (16.3)	10 (20.4)	0.620
		Absent/Mild	5 (10.2)	34 (69.4)	39 (70.6)	
	Awake Bruxism	Present	6 (10.9)	7 (12.7)	13 (23.6)	**0.003**
		Absent	3 (5.5)	39 (70.9)	42 (76.4)	
	Sleep Bruxism	Present	4 (7.4)	2 (3.7)	6 (11.1)	**0.005**
		Absent	5 (9.3)	43 (79.6)	48 (88.9)	

*Fisher's Exact Test.
Values in bold indicate statistical significance (p<0.05)
Values below 69 indicate incomplete data

However, the multivariate analysis identified that just the preoperative variable “Pain beyond the Face” (PR= 3.93; 95% CI: 1.38–11.18; *p= 0.010*), and the postoperative variables “Intra-articular disorder” (PR= 4.09; 95% CI: 1.02–16.76; *p= 0.050*) and “Awake Bruxism” (PR= 5.46; 95% CI: 1.07–27.83; *p= 0.041*), remained independently and significantly associated with the presence of postoperative arthralgia, as detailed in Table 2.

TABLE 2- MULTIPLE ASSOCIATION ANALYSIS BETWEEN POSTOPERATIVE ARTHRALGIA AND INDEPENDENT VARIABLES (N=49†); CURITIBA, BRAZIL)

PREDICTORS		**p-value**	**RP$_a$**	**95% CI**
Class	III	0.595	1	0.34 – 6.42
	II		1.48	
Arthralgia (T0)	Absent	0.704	1	0.26 – 7.36
	Present		1.38	
Pain Beyond Face (T0)	Absent	**0.010**	**1**	**1.38 – 11.18**
	Present		**3.93**	
Intra-articular Disorder (T1)	Absent	**0.050**	**1**	
	Present		**4.09**	**1,02 – 16.76**
Awake Bruxism (T1)	Absent	**0.041**	**1**	
	Present		**5.46**	**1.07– 27.83**

† Reduced N reflects missing data and cases excluded due to model non-convergence.
RP Adjusted prevalence ratio
Multivariate Poisson Regression Model with robust variance
CI = 95% confidence interval

DISCUSSION

The present study investigated factors associated with the persistence or development of postoperative arthralgia in patients with DFD undergoing OS, considering anatomical, clinical, and psychosocial variables. It is important to highlight that most patients did not develop arthralgia after surgery, with only a small proportion experiencing either new-onset or persistent symptoms.

Among the most relevant predictors identified in univariate analyses, variables related to the presence of previous pain stood out, both local (arthralgia) and widespread ("pain beyond the face"). The latter remained statistically significant in the multivariate model, indicating its robust association with the occurrence of postoperative articular pain. The literature corroborates this finding by demonstrating that the presence of pain in multiple body

sites is frequently associated with central sensitization phenomena, which amplify nociceptive perception and favor pain chronification, even in the face of moderate peripheral stimuli (16-19). These patients, often already vulnerable from a neurophysiological standpoint, may present lower adaptive capacity when facing surgical stress, making them more susceptible to pain perpetuation (20). These results highlight the importance of comprehensive pain assessment before surgery, emphasizing the need for targeted management strategies for patients at increased risk of persistent postoperative arthralgia. It is worth noting that although preoperative arthralgia showed significant association in univariate analysis, this relationship was not maintained in the multivariate model. A possible explanation is that the concomitant presence of arthralgia acted as a confounding factor among patients who presented “pain beyond the face”, reflecting a more complex and diffuse clinical pattern. In this situation, local articular pain possibly does not represent an isolated manifestation, but rather part of a broader spectrum of central sensitization and pain amplification (16).

Although the literature points out that transoperative variables—such as the magnitude of mandibular advancement, maxillomandibular complex rotation (1), and type of fixation (9) may influence TMD-related outcomes postoperatively, such factors did not demonstrate significant association with arthralgia in this sample. Counterclockwise rotation, frequently associated with greater muscle and articular tension, and mandibular advancements greater than 5 mm, considered potentially destabilizing to condylar position, were not relevant in this context. The "mandibular advancement" variable was included in the multivariate model but did not adjust robustly, suggesting that its contribution to the painful outcome is secondary compared to other factors. This finding reinforces the hypothesis suggested earlier that, more than isolated technical or anatomical factors, the development or persistence of articular pain seems to be more strongly linked to the adaptive capacity of the stomatognathic system, mediated by neurophysiological and psychosocial aspects. Thus, even technically well-executed procedures may not prevent pain in patients with greater neurobiological or emotional vulnerability—which highlights the importance of multidimensional assessment in surgical planning (21).

Among the postoperative variables analyzed, articular overload resulting from SB and AB emerged as a determining factor. A significant reduction in parafunctional behaviors was observed postoperatively, possibly mediated by surgical trauma, which promotes greater body awareness and behavioral modulation, and by improvement in self-image, quality of life, and masticatory function after DFD correction (22,23). However, patients who maintai-

ned AB after surgery presented a five-fold higher risk of developing or persisting with arthralgia. Similar results were found by Bruguiere (24) in the DFD population. AB, defined as repetitive and non-functional diurnal masticatory muscle activity, imposes chronic mechanical load on the TMJ, hindering its adaptation to the new biomechanics generated by OS. This overload can perpetuate inflammatory processes and delay articular remodeling, compromising the functional stability of the TMJ postoperatively (25-27). Additionally, although SB is also a factor frequently related to TMD, recent studies point to a more robust association of AB with articular and muscle pain, probably due to its frequency, duration, and more direct link with cognitive factors such as concentration, anxiety, and hypervigilance, prevalent in our young adult population (28-30). These findings support the need to implement systematic AB screening protocols in all treatment phases and develop multidisciplinary interventions integrating cognitive-behavioral approaches with post-discharge monitoring (15). The discontinuation of follow-up after surgical discharge represents a critical gap in the care of these patients, potentially compromising functional outcomes in the medium and long term (24).

Current literature has advanced the understanding of bruxism, demonstrating its association with structural alterations of the TMJ, due to its nature as a continuous and poorly self-regulated overload (31). This behavior necessitates constant adaptive responses from articular structures, becoming even more critical following the new maxillomandibular relationship established by OS. In the present study, intra-articular disorders showed a significant association with postoperative arthralgia, maintaining relevance even after adjustment for factors related to pain modulation and functional overload. Notably, patients who developed postoperative arthralgia manifested intra-articular disorders after surgery, suggesting an increased adaptive demand that may exceed the TMJ's capacity during this period. Another aspect worth considering is the possibility that some patients might have had subclinical intra-articular disorders preoperatively, which went undetected and subsequently became symptomatic due to surgical stress and new functional demands. The presence of intra-articular disorders remains a controversial topic within the field of OS. Early studies advocated concomitant surgical interventions, such as discopexy, alongside OS (32-34). However, accumulated long-term evidence has led to a more conservative approach, restricting invasive procedures to selected cases based on clear clinical symptoms rather than imaging findings alone. In this study, postoperative arthralgia was correlated solely with postoperative intra-articular alterations rather than preoperative ones. This observation indica-

tes that most patients with preexisting articular disorders adapt adequately to the new articular dynamics postoperatively, reinforcing current guidelines that advise against routine invasive TMJ interventions (35).

Skeletal malocclusion (Class II or Class III) was not significantly associated with postoperative arthralgia in adjusted models. This finding is aligned with previous studies that also did not identify greater susceptibility of one skeletal type over another for the development of articular pain after OS (1,5). Despite theories suggesting that patients with skeletal malocclusion Class II, especially those with hyperdivergent pattern, have greater predisposition to articular alterations due to characteristics such as retropositioned mandible and smaller condyles, much of these conclusions derive from univariate analyses or cross- sectional studies with low methodological robustness (2,34). It is important to highlight that, regardless of skeletal malocclusion, OS imposes functional reorganization of the TMJ, thus requiring its adaptive capacity. Fortunately, longitudinal evidence with imaging examinations suggests that, in most cases, this process occurs asymptomatically and without relevant functional impairment (1). However, when adaptation is not successful, especially in patients with skeletal Class II, the literature shows greater risk for events such as progressive condylar resorption and persistent articular symptoms (36). Our findings reinforce the importance of considering skeletal malocclusion within a broader multifactorial context, in which clinical and behavioral variables—such as bruxism and widespread pain—may play a determining role.

Among the strengths of this study are its prospective design, robust multivariate analysis, and the use of validated clinical instruments applicable to clinical practice. However, some limitations should be acknowledged. The relatively short follow-up period may have limited the detection of recurrence or late manifestations of pain, especially given the variable course of TMD over time. Additionally, the small sample size within certain subgroups might have reduced the statistical power to detect less pronounced effects. Variables with recognized potential for interference, such as masticatory efficiency, objective measures of mandibular function, additional psychological aspects, and imaging examinations, were not included in this methodology and should be considered in future studies. Such an approach could enhance the understanding of mechanisms that perpetuate postoperative joint pain and support the development of personalized strategies for prevention and management of arthralgia in patients with DFD undergoing OS.

CONCLUSION

The persistence or development of postoperative arthralgia was associated with the preoperative presence of pain beyond the facial region, as well as postoperative awake bruxism and intra-articular disorders.

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6. CONCLUSÕES

Esta pesquisa demonstrou que a artralgia temporomandibular em indivíduos com DDF candidatos à CO esteve associada a diferentes fatores conforme a maloclusão esquelética. Nos pacientes Classe II, predominaram determinantes morfológicos, como sexo feminino, excesso vertical da maxila e deslocamento de disco, indicando maior influência de características anatômicas e biomecânicas. Já nos pacientes Classe III, fatores psicossociais e comportamentais, como ansiedade, somatização, má qualidade do sono, BV e DTM muscular, exerceram papel mais relevante na manifestação da dor.

No acompanhamento pós-operatório, a persistência ou o surgimento de artralgia esteve associado à presença prévia de dor além da face, as variáveis pós-operatórias BV e a desordens intra-articulares. Esses achados reforçam a necessidade de uma avaliação multidimensional e de estratégias personalizadas no planejamento e no manejo desses pacientes, com foco na identificação precoce de fatores de risco e na prevenção da dor.

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8.APÊNDICES

8.1 APÊNDICE 1

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Nós, Rafaela Scariot e Aline Sebastiani (professoras do Departamento de Estomatologia do curso de Odontologia da Universidade Federal do Paraná), junto com Danielle V. Bonotto e Alice V. Miotto (alunas do Programa de Pós-Graduação em Odontologia, doutorado e mestrado respectivamente), estamos convidando o(a) senhor(a) que buscou tratamento no Serviço de Odontologia da Universidade Federal do Paraná de forma voluntária para tratamento dentário ou para realização da cirurgia ortognática, a participar de um estudo intitulado "DISTÚRBIOS DO SONO E DISFUNÇÃO TEMPOROMANDIBULAR EM PACIENTES DE CIRURGIA ORTOGNÁTICA", para avaliar a qualidade do sono e a presença de dores na face ou alterações na abertura de boca. Esse estudo será importante para melhorar a compreensão e o tratamento destas alterações.

a) O objetivo dessa pesquisa é avaliar como problemas dentários e do perfil facial poderiam afetar os problemas respiratórios do sono e as dores na face e na mandíbula. E de que forma a cirurgia ortognática pode interferir nestas alterações. Verificaremos também alguns aspectos genéticos relacionados ao sono e a dor. Lembramos que é através das pesquisas clínicas que ocorrem os avanços importantes em toda as áreas, e sua participação é fundamental.

b) Caso o senhor concorde em participar da pesquisa, serão realizadas perguntas sobre a sua saúde geral (física e emocional), qualidade do seu sono, hábitos orais e sobre sintomas de dor na face. Você também será convidado a dormir com um aparelho que será conectado no dedo, e que vai demonstrar aspectos importantes do seu sono. Além disso será realizado um exame envolvendo palpação da sua face e a coleta do DNA através de um bochecho com uma solução de glicose e raspagem da bochecha com uma espátula.

c) Para tanto você deverá se dispor a participar da pesquisa durante as suas consultas nas clínicas de odontologia do campus Jardim Botânico da UFPR (Av. Prefeito Lothário Meissner, 623 - Jardim Botânico, Curitiba - PR, 80210-170). Neste estudo será utilizado um grupo de pacientes **sem deformidades dentárias e do perfil facial** e um grupo de pacientes **com deformidade dentárias e do perfil facial** que serão submetidos a cirurgia ortognática.

Participante da Pesquisa e/ou Responsável Legal:_____
Pesquisador Responsável ou quem aplicou o TCLE:_____
Orientador:_____

Comitê de ética em Pesquisa do Setor de Ciências da Saúde da FUFPR
Rua Pe. Camargo, 280 – 2º andar – Alto da Glória – Curitiba-PR –CEP:80060-240
Tel (41)3360-7259 - e-mail: cometica.saude@ufpr.br

Caso você pertença ao **grupo sem deformidades dentárias e do perfil facial** no dia do seu atendimento odontológico, você deverá responder os questionários e ser submetido ao exame clínico e a coleta do DNA. O que levará aproximadamente 20 minutos.

Caso você pertença ao grupo **com deformidades dentárias e do perfil facial** durante a consulta pré-operatória de 7 dias, e nas consultas pós-operatórias de 3 e 6 meses deverá responder os questionários e ser submetido ao exame clínico, levando em torno de 15 minutos. O DNA será coletado na consulta pré-operatória levando em torno de 5 minutos para a coleta.

Independente do grupo que pertença, você receberá emprestado o aparelho Biologix e um telefone celular com aplicativo do Biologix instalado que será utilizado em casa durante o sono (esse exame do sono será realizado em todos os participantes da pesquisa). As orientações de uso serão fornecidas pelos pesquisadores. Este aparelho deverá ser devolvido no seu próximo retorno a UFPR.

d) É possível que o (a) senhor (a) experimente algum desconforto, principalmente relacionado ao momento da realização do exame para verificar se há alguma dor ou limitação na região da face, e durante coleta da saliva e raspagem da bochecha com espátula.

e) Alguns riscos relacionados ao estudo podem ser constrangimento ao responder os questionários e durante o exame. Para evitar isso, você será avaliado individualmente em uma sala sem a presença de outros pacientes. Quanto aos riscos dos procedimentos a serem realizados, serão esclarecidos pelo cirurgião dentista responsável pelo tratamento.

g) Os benefícios esperados com essa pesquisa são compreender a associação das deformidades dentárias e do perfil facial com os problemas respiratórios do sono, função da mandíbula e as dores na face e verificar de que forma a cirurgia ortognática interfere nestas condições. E assim desenvolver novas formas de tratamento a estes indivíduos para melhorar sua qualidade de vida e a função mastigatória.

Participante da Pesquisa e/ou Responsável Legal:_____
Pesquisador Responsável ou quem aplicou o TCLE:_____
Orientador:_____

Comitê de ética em Pesquisa do Setor de Ciências da Saúde da FUFPR
Rua Pe. Camargo, 280 – 2º andar – Alto da Glória – Curitiba-PR –CEP:80060-240
Tel (41)3360-7259 - e-mail: cometica.saude@ufpr.br

h) Os pesquisadores responsáveis por este estudo (Rafaela Scariot, Aline Sebastiani, Danielle Bonotto e Alice Miotto) poderão ser localizados no Departamento de Estomatologia no prédio de Odontologia – Campus Jardim Botânico da Universidade Federal do Paraná (Av. Prefeito Lothário Meissner, 623 - Jardim Botânico, Curitiba - PR, 80210-170) ou contactados pelo telefone (41) 3360-4020, nos dias úteis das 13:30 às 17:30 horas ou pelos e-mails rafaela_scariot@yahoo.com.br, sebastiani.aline@gmail.com, dvbonotto@gmail.com e alicevmiotto@gmail.com para esclarecer eventuais dúvidas a respeito desta pesquisa, e fornecer-lhe as informações que queira, antes, durante ou depois de encerrado o estudo. Em caso de emergência o (a) senhor (a) também pode me contatar (Danielle Bonotto), neste número (41) 99928-9982, em qualquer horário.

i) A sua participação neste estudo é voluntária e se o(a) senhor(a) não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento e solicitar que lhe devolvam este Termo de Consentimento Livre e Esclarecido assinado. O seu atendimento e/ou tratamento está garantido e não será interrompido caso você desista de participar.

j) O material obtido – amostras biológicas, questionários, imagens – será utilizado unicamente para essa pesquisa e será destruído/descartado ao término do estudo, dentro de 5 anos.

k) As informações relacionadas ao estudo poderão ser conhecidas por pessoas autorizadas, são elas a orientadora Rafaela Scariot e responsáveis pela pesquisa Aline Sebastiani, Danielle V. Bonotto e Alice V. Miotto, sob forma codificada, para que a sua identidade seja preservada e mantida a confidencialidade.

l) O(a) senhor(a) terá a garantia de que quando os dados/resultados obtidos com este estudo forem publicados, não aparecerá seu nome.

m) As despesas necessárias para a realização da pesquisa (impressão de questionários, equipamentos utilizados) não são de sua responsabilidade e o (a) senhor(a) não receberá qualquer valor em dinheiro pela sua participação. Entretanto, caso seja necessário seu deslocamento até o local do estudo os pesquisadores asseguram o ressarcimento dos seus gastos com transporte (Item II.21, e item IV.3, sub-item g, Resol. 466/2012).

Participante da Pesquisa e/ou Responsável Legal:_____
Pesquisador Responsável ou quem aplicou o TCLE:_____
Orientador:_____

Comitê de ética em Pesquisa do Setor de Ciências da Saúde da FUFPR
Rua Pe. Camargo, 280 – 2º andar – Alto da Glória – Curitiba-PR –CEP:80060-240
Tel (41)3360-7259 - e-mail: cometica.saude@ufpr.br

n) Quando os resultados forem publicados, não aparecerá seu nome, e sim um código.

o) Se o(a) senhor(a) tiver dúvidas sobre seus direitos como participante de pesquisa, poderá contatar também o Comitê de Ética em Pesquisa em Seres Humanos (CEP/SD) do Setor de Ciências da Saúde da Universidade Federal do Paraná, pelo e-mail cometica.saude@ufpr.br e/ou telefone 41 -3360-7259, das 08:30h às 11:00h e das 14:00h.às 16:00h.

O Comitê de Ética em Pesquisa é um órgão colegiado multi e transdisciplinar, independente, que existe nas instituições que realizam pesquisa envolvendo seres humanos no Brasil e foi criado com o objetivo de proteger os participantes de pesquisa, em sua integridade e dignidade, e assegurar que as pesquisas sejam desenvolvidas dentro de padrões éticos (Resolução nº 466/12 Conselho Nacional de Saúde).

Eu,_____ li esse Termo de Consentimento e compreendi a natureza e o objetivo do estudo do qual concordei em participar. A explicação que recebi menciona os riscos e benefícios. Eu entendi que sou livre para interromper minha participação a qualquer momento sem justificar minha decisão e sem qualquer prejuízo para mim e sem que esta decisão afete meu tratamento. Eu concordo, voluntariamente, em participar deste estudo.

Curitiba, ___ de _____ de _____

_____

[Assinatura do Participante de Pesquisa ou Responsável Legal]

Eu declaro ter apresentado o estudo, explicado seus objetivos, natureza, riscos e benefícios e ter respondido da melhor forma possível às questões formuladas.

Rafaela Assaid de Moraes _____

[Assinatura do Pesquisador Responsável ou quem aplicou o TCLE]

Participante da Pesquisa e/ou Responsável Legal:_____
Pesquisador Responsável ou quem aplicou o TCLE:_____
Orientador:_____

Comitê de ética em Pesquisa do Setor de Ciências da Saúde da FUFPR
Rua Pe. Camargo, 280 – 2º andar – Alto da Glória – Curitiba-PR –CEP:80060-240
Tel (41)3360-7259 - e-mail: cometica.saude@ufpr.br

8.2 APÊNDICE 2

PARECER CONSUBSTANCIADO DO COMITÊ DE ÉTICA EM PESQUISA

UFPR - SETOR DE CIÊNCIAS DA SAÚDE DA UNIVERSIDADE FEDERAL DO PARANÁ - SCS/UFPR

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: DISTÚRBIOS DO SONO E DISFUNÇÃO TEMPOROMANDIBULAR EM PACIENTES DE CIRURGIA ORTOGNÁTICA

Pesquisador: RAFAELA SCARIOT

Área Temática: Genética Humana:
(Trata-se de pesquisa envolvendo Genética Humana que não necessita de análise ética por parte da CONEP;);

Versão: 2

CAAE: 52207821.9.0000.0102

Instituição Proponente: Departamento de Estomatologia

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.153.884

Apresentação do Projeto:

O projeto e coordenado pela professora Rafaela Scariot (Departamento de Estomatologia) com colaboracao da professora Aline Sebastiani (Departamento de Estomatologia), Danielle Bonotto (aluna de doutorado) e Alice Miotto (aluna de mestrado).

O periodo previsto para a execucao e apos a aprovacao do CEP ate dezembro/2024.

Trata-se de um estudo observacional longitudinal do tipo caso-controle que sera desenvolvido nas dependencias do Servico de Cirurgia e Traumatologia Bucomaxilofacial (CTBMF) e nas clinicas odontologicas do departamento de Estomatologia da Universidade Federal do Parana (UFPR), Espera-se com os resultados desta pesquisa identificar os principais fatores de risco relacionados com a manifestacao da Apneia Obstrutiva do Sono (AOS) e das DTM em pacientes com deformidades dentofaciais e compreender o impacto da cirurgia ortognatica nos disturbios do sono e no diagnostico das DTM. Pretende-se incluir 160 participantes na pesquisa.

Objetivo da Pesquisa:

Objetivo geral

Avaliar a prevalencia de sinais e sintomas da Apneia Obstrutiva do Sono (AOS) e de Disfuncao Temporomandibular (DTM) em pacientes com deformidades dentofacial (DDF) que buscam a

cirurgia ortognatica. E a influencia da cirurgia ortognatica nestas alteracoes.

Objetivos especificos

• Avaliar a relacao entre as DDF e sinais e sintomas de AOS;
• Avaliar a relacao entre as DDF e as Disfuncoes Temporomandibulares (DTM);
• Identificar possiveis fatores de risco [sexo, idade, raca autoreportada, indice de massa corporea (IMC) e diametro do pescoco] para a ocorrencia da AOS e de outros disturbios do sono em pacientes com DDF que buscam a cirurgia ortognatica;
• Avaliar a influencia das movimentacoes cirurgicas nos sinais e sintomas da Apneia Obstrutiva do Sono (AOS);
• Correlacionar as caracteristicas dos individuos: sexo, idade, indice de massa corporea (IMC) e diametro do pescoco com a evolucao dos sinais e sintomas de AOS apos a cirurgia ortognatica;
• Avaliar a influencia das movimentacoes cirurgicas nos diagnosticos de DTM;
• Investigar a relacao da AOS e o Bruxismo do Sono (BS), nesta populacao antes e apos a cirurgia ortognatica;
• Investigar a relacao da AOS e da DTM, nesta populacao antes e apos a cirurgia ortognatica;
• Investigar a associacao entre BS e DTM, nesta populacao antes e apos a cirurgia ortognatica;
• Verificar a associacao entre polimorfismos no gene da melatonina (MTNR1A) com a AOS e outros disturbios do sono.

Avaliação dos Riscos e Benefícios:

Quais os beneficios, diretos ou indiretos, para a populacao e a sociedade?

Os beneficios agregados a pesquisa estao vinculados ao maior entendimento do papel do tratamento cirurgico nos disturbios do sono e nas DTM em diferentes padroes de deformidades faciais, desse modo aumentando a previsibilidade da indicacao cirurgica para essas condicoes.
O estudo contribuira ainda no tratamento das AOS, ja que algumas alteracoes esqueleticas da maxila e mandibula diminuem o volume das vias aereas superiores dificultando a passagem de ar. A correcao cirurgica dessas condicoes diminuira os indices de AOS e as consequencias da AOS como: acidentes de trabalho, acidentes de transito, deficit cognitivo doencas cardiovasculares, desregulacao metabolica, diabetes, acidentes de trabalho, acidentes de transito e deficit cognitivo.
O estudo visa ainda preencher lacunas no conhecimento de fatores etiologicos de risco para a

manifestacao dos disturbios do sono e DTM.

Quais os riscos inerentes ou decorrentes da pesquisa?

Os riscos que a pesquisa pode apresentar e uma possivel quebra de confidencialidade (muitas vezes devido ao local onde serao aplicados os questionarios), constrangimento do paciente (devido a perguntas pessoais que para ele nao sejam necessarias e no momento de aferir medida da circunferencia do pescoco e o peso, contudo, para a pesquisa se tornam importantes) alem de existir a possibilidade do paciente sentir um leve desconforto durante a coleta da saliva (no momento da raspagem da mucosa jugal para coleta das celulas bucais) e tambem pode ocorrer sensibilidade leve durante o exame fisico para o diagnostico de DTM (palpacao dos musculos da mastigacao e ATM).
Os dados dos participantes terao sigilo e somente os pesquisadores diretamente envolvidos na pesquisa terao acesso a essas informacoes.

Qual a possibilidade da ocorrencia?

Minima, pois em todas as etapas os pesquisadores estarao atentos e prestando os devidos cuidados para nao ocasionar nenhum incomodo ou constrangimento ao participante da pesquisa. Vale ressaltar que sera esclarecido ao participante que ele podera desistir de participar da pesquisa em qualquer momento, sem nenhum onus e que em caso de desconforto durante a raspagem da mucosa jugal para coleta de DNA, essa podera parar a qualquer momento que o participante desejar.

Quais as medidas para sua minimizacao e protecao do participante da pesquisa?

A pesquisa ficara restrita somente aos pesquisadores aqui citados, ficando sobre responsabilidade dos mesmos esclarecer todas as duvidas dos participantes bem como explicar a importancia de cada passo presente no estudo, desde o preenchimento da ficha de informacoes individuais de cada um ate a coleta fisica de dados acerca da presenca de disfuncao temporomandibular. Para evitar possiveis problemas mencionados no item 8.2 desse projeto, havera um cuidado redobrado no arquivamento das informacoes extraidas e na busca de um lugar que vise conforto ao participante, para que assim ele possa sentir-se bem durante os poucos minutos que participara

do estudo. Para a coleta de saliva e celulas da mucosa jugal do paciente, uma alternativa para minimizar o desconforto ao realizar a raspagem da mucosa com espatula de madeira, e realizar o procedimento em local reservado, estando presente somente o pesquisador e o participante. Outra possibilidade e realizar movimento unico de raspagem da mucosa e alertar o participante que em caso de desconforto o procedimento sera interrompido ate que ele se sinta confortavel para realizar novamente. Caso o desconforto seja demais ao participante o mesmo pode optar por nao realiza-lo. Vale ressaltar que os participantes diagnosticados com DTM serao encaminhados para atendimento na Especializacao de DTM e Dor Orofacial da UFPR no final da pesquisa.

Comentários e Considerações sobre a Pesquisa:

Nao havera necessidade de ressarcimento de gastos.

Todos os exames complementares serao realizados conforme protocolo do Servico de Cirurgia e Traumatologia Bucomaxilofacial da Universidade Federal do Parana e pela necessidade do tratamento. As avaliacoes serao realizadas em momento oportuno ao participante evitando deslocamentos adicionais. Como os participantes serao pacientes eletivos do proprio Servico de Cirurgia e Traumatologia Bucomaxilofacial da UFPR, estes nao serao exclusivos da pesquisa e nao precisarao ter gastos especificos para participarem da mesma. Assim, nao havera nenhum tipo de ressarcimento por parte dos pesquisadores para com os participantes, sendo de cunho voluntario a participacao da amostra a ser estudada.

Considerações sobre os Termos de apresentação obrigatória:

Os termos foram apresentados.

Recomendações:

Não há.

Conclusões ou Pendências e Lista de Inadequações:

As pendências apontadas no parecer anterior foram atendidas. Sou favorável à aprovação do projeto.

Favor inserir em seu TCLE e TALEo número do CAAE e o número deste Parecer de aprovação, para que possa aplicar aos participantes de sua pesquisa, conforme decisão da Coordenação do CEP/SD de 13 de julho de 2020.

Após o isolamento, retornaremos à obrigatoriedade do carimbo e assinatura nos termos para

novos projetos.

Considerações Finais a critério do CEP:

Solicitamos que sejam apresentados a este CEP, relatórios semestrais(a cada seis meses de seu parecer de aprovado) e final, sobre o andamento da pesquisa, bem como informações relativas às modificações do protocolo, cancelamento, encerramento e destino dos conhecimentos obtidos, através da Plataforma Brasil - no modo: NOTIFICAÇÃO. Demais alterações e prorrogação de prazo devem ser enviadas no modo EMENDA. Lembrando que o cronograma de execução da pesquisa deve ser atualizado no sistema Plataforma Brasil antes de enviar solicitação de prorrogação de prazo.

Emenda – ver modelo de carta em nossa página: www.cometica.ufpr.br (obrigatório envio).

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1807483.pdf	24/11/2021 05:33:24		Aceito
Outros	carta_pendencias.docx	24/11/2021 05:29:03	RAFAELA SCARIOT	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_Detalhado_corrigido.docx	24/11/2021 05:28:29	RAFAELA SCARIOT	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_corrigido.docx	24/11/2021 05:27:56	RAFAELA SCARIOT	Aceito
Folha de Rosto	Folha_de_rosto.pdf	29/09/2021 21:24:51	RAFAELA SCARIOT	Aceito
Projeto Detalhado / Brochura Investigador	Projeto_Detalhado.docx	26/09/2021 07:53:14	RAFAELA SCARIOT	Aceito
Outros	carta_de_encaminhamento_do_pesquisador_ao_CEP.pdf	24/09/2021 07:21:47	RAFAELA SCARIOT	Aceito
Outros	Analise_de_merito.pdf	24/09/2021 07:09:05	RAFAELA SCARIOT	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.docx	24/09/2021 07:06:05	RAFAELA SCARIOT	Aceito

Outros	Check_List.pdf	14/09/2021 17:05:26	RAFAELA SCARIOT	Aceito
Declaração de Pesquisadores	DECLARA_DE_COMPROMISSOS_DA_EQUIPE_DA_PESQUISA.pdf	09/09/2021 08:27:27	RAFAELA SCARIOT	Aceito
Outros	Extrato_ATA.pdf	09/09/2021 08:24:08	RAFAELA SCARIOT	Aceito
Declaração de Manuseio Material Biológico / Biorepositório / Biobanco	termo_guarda_material_biol.pdf	09/09/2021 08:21:10	RAFAELA SCARIOT	Aceito
Declaração de Instituição e Infraestrutura	Concordancia_dos_servicos_envolvidos.pdf	09/09/2021 08:20:37	RAFAELA SCARIOT	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

CURITIBA, 08 de Dezembro de 2021

Assinado por:
IDA CRISTINA GUBERT
(Coordenador(a))

8.3 APÊNDICE 3

CÓDIGO DA REPRESENTAÇÃO CONCEITUAL DA ARTRALGIA EM PACIENTES COM DDF POR *DIRECTED ACYCLIC GRAPH* (DAG).

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Ansiedade -> BruxismoSono
Ansiedade -> BruxismoVigilia
Ansiedade -> DTMmuscular
Ansiedade -> DorFace

Ansiedade -> Somatizacao
ArtralgiaT0 -> Artralgia AvancoMandMaior5mm -> Artralgia AvancoMandMaior5mm -> DeslocamentoDisco
BruxismoSono -> Artralgia

BruxismoSono -> DTMmuscular BruxismoVigilia -> Artralgia BruxismoVigilia -> DTMmuscular DTMmuscular
-> Artralgia DeslocamentoDisco -> Artralgia DorAlemFace -> Artralgia DorFace -> Artralgia

DorFace -> DorAlemFace ExcessoVerticalMaxila -> Artralgia ExcessoVerticalMaxila -> DeslocamentoDisco
FixacaoBicortical -> Artralgia
IdadeCateg -> Ansiedade
IdadeCateg -> Artralgia
IdadeCateg -> Somatizacao PerfilEsqueleticoII -> Artralgia PerfilEsqueleticoII -> DeslocamentoDisco
PerfilEsqueleticoII -> ExcessoVerticalMaxila QualidadeSonoRuim -> Ansiedade QualidadeSonoRuim ->
Artralgia QualidadeSonoRuim -> BruxismoSono RotacaoAntiHoraria -> Artralgia
Sexo -> Ansiedade
Sexo -> Artralgia
Sexo -> BruxismoSono
Sexo -> BruxismoVigilia
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Somatizacao -> Artralgia
Somatizacao -> DTMmuscular
Somatizacao -> DorAlemFace
Somatizacao -> DorFace
}
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8.4 APÊNDICE 4-

ARTIGO COMPLEMENTAR

Vol. 139 No. 3 March 2025

Stratification of orthognathic surgery patients for painful TMD and associated factors

Danielle Veiga Bonotto, PhD,[a] Jessica Sarah Cavalheiro[a] Ramon Targino Firmino, PhD,[b] Juliana Stuginski-Barbosa, PhD,[c] Rafaela Scariot, PhD,[a] and Aline Monise Sebastiani, PhD[a]

Objective. To identify clusters of patients with DFD based on variables related to TMD, psychological aspects, somatization, oral habits, and sleep.

Method. Ninety-two patients with DFD were evaluated before orthognathic surgery according to demographic data, facial profile, presence of painful TMD (DC/TMD), psychological aspects, oral habits, comorbidities, substance use, and sleep quality.

Results. Eighty-six individuals comprised the final sample. The K-means cluster analysis identified two distinct but internally similar groups. One called "Vulnerable" with a higher prevalence of muscular TMD and associated factors with 43 (50%) participants, and another with 43 (50%) participants, called "Adaptive" with a lower prevalence of these variables ($P<.01$). The determining variables were signs and symptoms of anxiety and somatization, awake bruxism and self-reported sleep quality. The presence of arthralgia, comorbidities, or smoking did not influence the formation of the groups. The clusters were tested with gender, age, facial profile, maxillary excess, and deficiency. Only females were associated with the vulnerable group ($P=.015$). These results highlight the importance of multidimensional assessment of patients with DFD. The stratification of these individuals can help with personalized treatment, targeting specific strategies for each group, such as behavioral interventions and referrals to a multidisciplinary team. (Oral Surg Oral Med Oral Pathol Oral Radiol 2025;139:279–288)

Dentofacial deformities (DFD) are characterized by dental malocclusion associated with skeletal changes affecting the maxilla and/or mandible. The recommended treatment for moderate and severe cases involves orthodontics combined with orthognathic surgery.[1]

For decades, the literature has pointed to a high prevalence of temporomandibular disorder (TMD) in this group, suggesting that these musculoskeletal disharmonies require great adaptive capacity from their hosts, in addition to the emotional and social implications faced by these patients.[2] However, in the current understanding, which transcends purely mechanical etiological perspectives, a complex multidimensional model is emerging that has not yet been fully clarified.[2] The available literature suggests that the etiological variables that most influence the development of TMD are associated with psychological aspects, health status such as somatization,[2] and certain oral behaviors, such as bruxism.[3] In addition, there are clinical conditions that contribute to the chronification of TMD, such as poor sleep quality, painful comorbidities and alterations in pain processing.[4] Given this framework, upon successful evidence-based validation, dental occlusion factors and intermaxillary relationships are considered to have low relevance in the manifestation of TMD.[5]

In this context, patients eligible for orthodontic-surgical treatment and surgeons often face uncertainties regarding the manifestation of TMD, given the complexity of managing these conditions during preoperative preparation and their postsurgical evolution. Despite efforts in the literature to understand the relationship between DFD and TMD, there are still gaps on this topic. It is known that the signs and symptoms of TMD in individuals with DFD during the presurgical orthodontic treatment phase are high when compared to groups without DFD.[6]

The stratification approaches can help bridge the diagnostic gap and develop individualized therapeutic approaches. Subdividing individuals according to factors associated with TMD, psychological profiles and other baseline characteristics allows for a more objective approach, with immediate referral to a

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https://doi.org/10.1016/j.oooo.2024.09.001

Statement of Clinical Relevance

Our study identified phenotypic profiles from factors associated with TMD in patients with dentofacial deformities requiring orthognathic surgery. These clinically relevant findings enable personalized treatment planning, improve surgical outcomes, and assist in managing pain and associated comorbidities.

multidisciplinary team and behavioral guidance in order to enhance treatment results.[4,7,8]

The aim of this study was to identify groups of patients with DFD in terms of variables related to TMD, psychological aspects, somatization, oral habits, and sleep.

METHODS

Study design

This cross-sectional observational study was conducted over 18 months (from February 2022 to August 2023) and involved all patients with DFD undergoing preoperative orthodontic treatment for orthognathic surgery at the Oral and Maxillofacial Surgery and Traumatology Service of the Department of Stomatology at the Federal University of Paraná (UFPR), located in Southern Brazil. The study was approved by the Research Ethics Committee under protocol number CAAE: 52207821.9.0000.0102. Additionally, it adhered to all the recommendations of the Helsinki Declaration regarding human research. Participants were invited to join the study during one of their preoperative consultations, no more than 2 months before the orthognathic surgery. At this time, they received detailed information about the research objectives and rationale through the Informed Consent Form and were informed about the potential benefits and risks involved. They were aware that their treatment would continue regardless of their decision to participate in the study and that they could withdraw at any time.

According to the inclusion criteria, individuals with DFD were selected who did not have cleft lip and palate or associated syndromes, required treatment through orthognathic surgery, and were over 18 years of age. The exclusion criteria included an inability to understand Portuguese, previous surgeries in the cervicofacial region, and severe cognitive and neurological impairments that could prevent understanding of the questionnaires and responding to the physical examination.

An initial investigation was carried out with the aim of validating the methodology and the suitability of the questionnaires, involving 10 patients with DFD who met the specific criteria for this study. The pilot study went smoothly, and after its conclusion, the established methodology was applied to the same 10 individuals were included in the global sample.

Demographic variables

Demographic variables, including gender, race, age, and smoking status, were self-reported by the participants. In addition, data was collected on the use of medication, the presence of comorbidities (fibromyalgia, arthritis/arthrosis, and gastroesophageal reflux), and tobacco consumption.

We categorized gender into male or female. Age was dichotomized into 18-30 years and over 31 years. Comorbidities were considered: absent or present. Tobacco users were defined as individuals who smoked more than 10 cigarettes per day.

Dentofacial deformities

The subjects underwent facial and radiographic analysis prior to surgery. To analyze the types of DFD, an experienced surgeon assessed the facial profile, classifying them into three categories: I, II, or III. Profile I represents a straight profile, while Profile II shows a negative step between the maxilla and mandible, corresponding to patients with mandibular retrognathism. Profile III shows a positive step between the maxilla and mandible, indicating anteroposterior maxillary deficiency, mandibular prognathism, or both. They were also assessed for mandibular asymmetry (greater than 4 mm) and vertical facial patterns: vertical maxillary excess, and vertical maxillary deficiency.[1,8]

TMD painful conditions detection

For the collection of clinical variables associated with TMD, the DC/TMD tools were utilized. The patient was evaluated by a specialist in TMD and Orofacial Pain (D.V.B.) who was previously trained and calibrated to use the tool.

The questionnaire consisted of self-reported physical symptoms, including details such as quality, location, and duration of pain. It also covers facial pain frequency, headaches, discomfort during jaw movements, difficulties in wide mouth opening, jaw fatigue/weight, and joint sounds.

A physical examination was then performed, which included assessing pain in the masticatory muscles and TMJ during jaw movements and calibrated palpation (pain site, familiarity, and reference pattern). Joint sounds (crepitus and clicking) and measurements and patterns of mouth opening (deviations, deflections, or subluxation) are also examined.

Using the collected data and following a diagnostic flowchart, the tool allowed for the establishment of two main groups of diagnoses for painful conditions: articular and muscular pain.

Psychosocial and sleep variables

Patient Health Questionnaire (PHQ-15) was used to investigate somatic aspects such as nausea, dizziness, and body pain. This instrument consists of 15 questions about general health conditions and physical symptoms and was classified according to the level of severity of these symptoms into absent/mild and moderate/severe symptoms.[9,10]

The Generalized Anxiety Disorder Questionnaire (GAD-7) was used to screen for anxiety and consists of

seven items to assess the signs and symptoms of anxiety.[11,12] In the study they were divided into absent/mild or moderate/severe signs and symptoms.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PITTS),[9] recognized as an excellent tool for assessing sleep quality in various aspects, investigated by its 7 domains. In our research, we used the variables relating to sleep (domains separately and global score) in order to identify which would be the most reliable way of classifying the quality of sleep of these individuals. Surprisingly, domain 6 of this questionnaire proved to be more effective in grouping individuals than the global score and other isolated domains. This domain consists of a single question: "During the last month, how would you rate the quality of your sleep in general?" The possible answers were dichotomized into very good/good and bad/very bad.[9,10]

Bruxism

Self-reported sleep bruxism (SB) and awake bruxism (AB) were identified through The Oral Behavior Checklist (OBC) questionnaire,[13] a 21-question instrument in which the patient reports the frequency of oral and parafunctional behaviors. Signs and symptoms of bruxism as hypertrophy of the masseter or temporal muscle; tongue swellings and/or a line alba on the inner cheek; damage to tooth structure (fractures or wear), pain or fatigue in the face in the morning and muscle and/or joint sensitivity were verified by physical examination. Muscle activity secondary to another neurological disorder, medication use, or drug addiction was ruled out using self-administered questions.

SB was classified as Possible: when there was only a weekly report of teeth grinding during sleep (question 1-OBC); Probable: when there was self-report associated with physical examination findings.[14,15]

SB was dichotomized into 1—absent and 2—possible or probable. AB was evaluated based on the frequency of daytime oral behaviors over 30 days (questions 3-6 of the OBC) and the physical examination findings described above to enhance the reliability of the AB diagnosis. AB was classified according to its frequency: absent/infrequent and frequent/very frequent.[16,17]

Data analysis

The data was organized and statistically analyzed using SPSS Statistics (SPSS for Windows, version 25.0, IBM Inc.). The data was analyzed descriptively using absolute and relative frequencies, measures of central tendency (mean), and dispersion (standard deviation).

Clustering

Cluster analysis was employed to identify distinct groupings within the sample based on diagnoses of muscle and joint pain, signs and symptoms of anxiety, somatic symptoms, AB, SB, sleep quality, smoking, and the presence of comorbidities. These variables were selected based on prior research, particularly the OPPERA (Orofacial Pain: Prospective Evaluation and Risk Assessment).[2,18] The nonhierarchical K-means method was used to form the groups by minimizing intra-cluster distances and maximizing inter-cluster distances according to the desired number of groups.[19] The clusters were identified using a supervised clustering method,[4] associated with the K-means method. Supervised clustering is useful in situations where you want to identify clusters associated with an outcome of interest based on many variables, some of which are weakly (or not at all) associated with the outcome. Initially, the hierarchical method was applied to determine the number of clusters, which suggested two internally homogeneous but distinct groups. Consequently, the final analysis was conducted using two clusters, resulting in a dichotomous variable labeled as "vulnerable" and "adaptive." The Chi-square test confirmed the distribution of all variables across these categories (Table I). The entire procedure for forming and validating the clusters is illustrated in Figure 1. The significance level adopted was 0.05%.

Clusters X independent variables

The relationship between the Vulnerable and Adaptive clusters was tested with the independent variables: age, gender, facial profile, maxillary deficiency, and maxillary excess.

RESULTS

Six individuals were identified as outliers, meaning they did not fit into any of the groups, and were subsequently excluded. This resulted in a final sample of 86 individuals. Cluster analysis identified two distinct yet internally homogeneous groups: Group A—Vulnerable, consisting of 43 participants (50%), and Group B—Adaptive, consisting of 43 participants (50%).

The median age was 30 years (18-61) of which 52 were women (56.5%) and 40 were men (43.5%). Regarding FDD, the sample was distributed as follows: 61% Class III, 30% Class II, and 9% Class I. Twenty-five percent had asymmetry. Vertical maxillary deficiency was found in 10% of the sample and vertical maxillary excess in 22.5%. Regarding TMD diagnoses, a total of 54% of participants had muscular TMD, and 43.5% were diagnosed with arthralgia.

One of the groups was labeled "Vulnerable" and had significantly higher frequencies of muscular TMD,

Table I. Characterization of the two groups formed according to the cluster analysis based on the scores of the instruments DC/TMD, PHQ-15, OBC, GAD-7 AND PITTS-component 6 (*N*=86)

Diagnosis and tools		*Vulnerable n (%)*	*Adaptive n (%)*	*Total*	*P value**
Muscular TMD (DC/TMD)	Without TMD myalgia	3 (7.3)	38 (92.7)	41	**<.001**
	With myalgia	40 (88.9)	5 (11.1)	45	
Symptoms Somatic (PHQ-15)	Without/low	2 (6.1)	31 (93.9)	33	**<.001**
	Medium/high	41 (77.4)	12 (22.6)	53	
Signs and symptoms of anxiety (GAD-7)	No/low anxiety	16 (29,6.)	38 (70.4)	54	**<.001**
	Moderate/high anxiety	27 (84.4)	5 (15.6)	32	
Awake bruxism (OBC)	Absent/infrequent	23 (38.3)	37 (61.7)	60	**<.001**
	Frequent/very frequente	20 (76.9)	6 (23.1)	26	
Sleep quality (PITTS-6)	Good/very good	21 (35.6)	38 (64.4)	59	**<.001**
	Bad/very bad	22 (81.5)	5 (18.5)	27	

*Chi-square test. Significant at the 5% level. The values in bold are statistically significant.

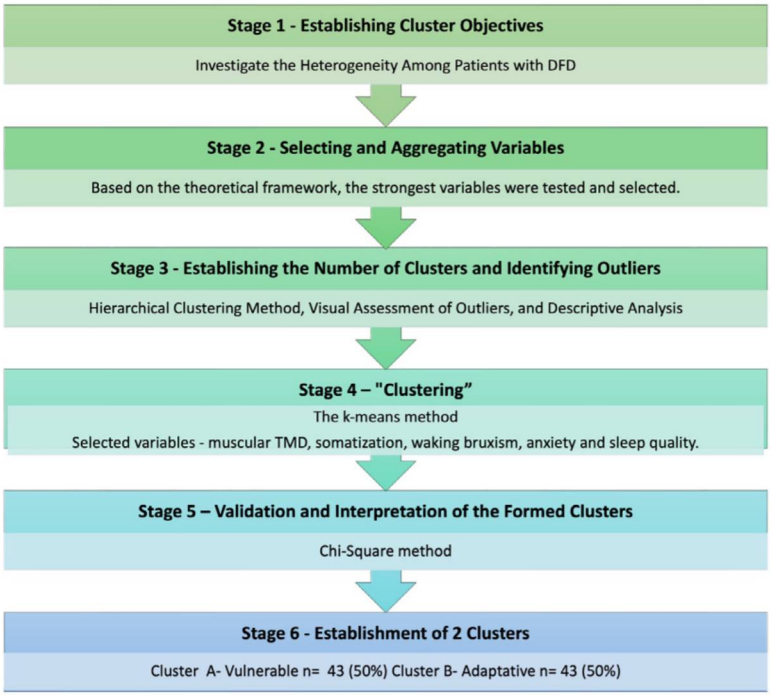

Fig. 1. Procedure for establishing clusters.

somatic symptoms, bruxism during waking hours, anxiety symptoms, and poorer sleep quality.

Conversely, another group, termed "Adaptive," showed a pattern with fewer signs and symptoms of anxiety and somatization, less painful muscular TMD, lower frequency of SB, and reported good or very good sleep quality. As a result, significant differences were found between the formed groups ($P<.001$) (Table I).

Figure 2 illustrates the preliminary analyses used to determine the importance of variables in the formation of clusters. Variables with little importance for cluster formation were excluded: presence of arthralgia, SB, smoking, and presence of comorbidities. Therefore, only the five most relevant variables were retained for cluster formation: diagnosis of muscular TMD (DC/TMD), and Axis II-related variables assessing signs and symptoms of somatization (PHQ-15), anxiety (GAD-7), SB (OBC), and subjective sleep quality (Component 6—PITTS).

Table II compares the clusters with individuals' demographic characteristics and types of DFD. It was observed that only sex showed a significant association, where most women were in the vulnerable group.

DISCUSSION

In this study, through cluster analysis, we identified relevant factors associated with painful TMD that allowed us to stratify patients with DFD candidates for orthognathic surgery into two groups: Vulnerable and Adaptive, with higher and lower presence of these factors, respectively. It is well established in the general population that in the face of painful conditions, including TMD, patients may exhibit adaptive behaviors and experience local or persistent symptoms. Although factors associated with TMD are well known, there is a growing need among surgeons to better stratify their patients who will undergo orthognathic surgery, aiming for better pre and postoperative management, as well as to determine the surgery prognosis in these different groups. There are informal, and even pejorative, reports of categorizing these patients as "black clouds," due to their catastrophic and multi-complaint profile, which leads to a worse coping with the surgical preparation process and postoperative phase, as well as greater dissatisfaction with long-term treatment. However, no study has been conducted so far to reliably define this stratification of candidates for orthognathic surgery.

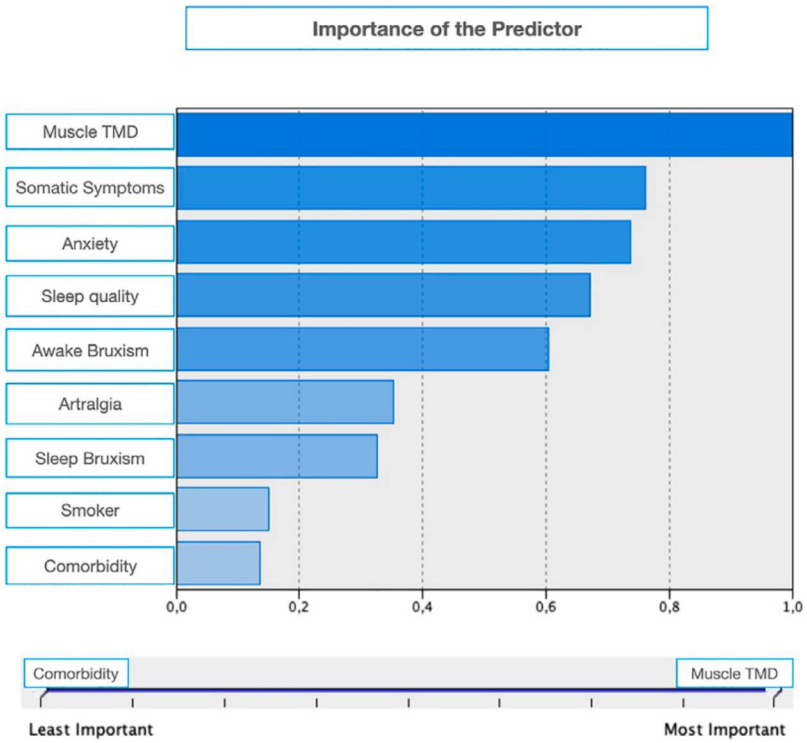

Fig. 2. Degree of importance of selected variables for cluster formation.

Table II. Demographic and facial profile characteristics assigned to the vulnerable and adaptive clusters (*N*=86)

Independent variables		*Vulnerable n (%)*	*Adaptive n (%)*	*Total*	*P value**
Facial profile	Class I	6 (85.7)	1 (14.3)	7	.150
	Class II	12 (48)	13 (52)	25	
	Class III	24 (48)	27 (52)	51	
Age	18-30 years old	22 (45.8)	26 (54.2)	48	.515
	Over 31 years old	21 (55.3)	17 (44.7)	38	
Sex	Male	14 (35.9)	25 (64.1)	39	**.015**
	Female	29 (61.7)	18 (38.3)	47	
Asymmetry	No	31 (50)	31 (50)	62	.526
	Yes	11 (52)	10 (47.6)	21	
Vertical excess of the maxilla	No	30 (48.8)	32 (51.6)	62	.617
	Deficiency	4 (66.7)	2 (33.3)	6	
	Excess	8 (53.3)	7 (46.7)	15	

*Chi-Square test. Significant at the 5% level. Values lower than 86 represent losses due to incomplete questionnaires or lack of imaging exams for diagnosis. The values in bold are statistically significant.

The literature indicates that patients with preparing for orthognathic surgery present a higher prevalence of signs and symptoms related to TMD.[20] The management of TMD in these patients is delicate and restricted in relation to certain therapeutic modalities such as interocclusal devices, which require the interruption of orthodontic movements. It is worth noting that this population has specific characteristics in psychosocial aspects, often related to low self-esteem due to facial deformity, as well as a high prevalence of sleep-related breathing disorders resulting from narrowed airways in certain types of DFD.[21,22] The use of the method proposed by our study would facilitate the prior identification of similar profiles of patients with signs and symptoms of TMD, allowing the surgeon to be more assertive in presurgical therapies and guidance, such as managing anxiety, sleep, and oral behaviors.

The identification of risk factors associated with TMD has greatly evolved with the OPPERA project.[2,18] This was the largest population-based study conducted to investigate physical, behavioral, biopsychosocial, and genetic risk factors associated with the onset and persistence of TMD. Many risk factors were identified, demonstrating the complexity of TMD etiology, reinforcing its biopsychosocial model, and the influence of behavioral factors.[2,18] In order to improve the clinical applicability of these findings, it is useful to predict which sets of these risk factors could group similar individuals. We used the TMD-associated factors reported by the OPPERA study to select the variables that would be most strongly capable of forming these groupings. Identifying clusters using all risk variables could compromise the quality of the resulting clusters, as irrelevant variables would add "noise" to the analyses. Therefore, the first step of this procedure selected the variables that were strongly associated with the formation of a cluster with more associated factors, which we called the "Vulnerable" cluster, and another where we found a lower presence of these factors, which we called the "Adaptive" cluster. The variables identified by cluster analyses as most effective for stratifying the population were: signs and symptoms of anxiety, presence of muscular TMD, AB, somatic symptoms, and reported sleep quality. It is interesting to note that these variables filled different etiological dimensions within the most accepted biopsychosocial model proposed by the OPPERA study.[2]

Cluster analyses have been explored in previous publications in populations already diagnosed with chronic pain and in initially asymptomatic populations that developed painful conditions during longitudinal follow-ups.[4,7] The main objective of those studies was to identify, through an algorithm, which patients were prone to manifestations or perpetuation of chronic

painful conditions. The Rapid OPPERA Algorithm identified 3 clusters with just 4 accessible clinical measures: pressure pain sensitivity in the trapezius muscle, signs and symptoms of anxiety and depression, and somatic aspects. The identified phenotypic groups presented different clinical characteristics and prognoses regarding the risk of pain chronification. These groups differed significantly in terms of reported pain, functional limitations, and comorbid conditions.[4] In our study, utilizing cluster analyses, it was possible to stratify the sample using only 5 clinically applicable variables and thus, identify two significantly distinct groups regarding the presence of risk factors associated with TMD.

The most important variable for the clustering of individuals was the diagnosis of muscular TMD. The importance of pain sensitivity in the masticatory muscles in sample stratification reinforces the hypothesis that certain individuals have reduced adaptive capacities due to their own endogenous pain mechanisms or due to other overlapping conditions. Next, the variable that proved effective in cluster formation was the presence of somatic symptoms. These symptoms refer to physical manifestations that do not have an identifiable medical cause but generate discomfort or significant dysfunction. The symptoms most frequently reported by patients include fatigue, dizziness, low energy, sleep problems, and pain.[14] However, the main characteristic of this pathology is how the individual experiences and interprets their symptoms. There is an interface between this condition and emotional aspects, such as anxious, depressive, and catastrophic patterns.[14,15] Nociceptive pain conditions, such as fibromyalgia, are also associated with somatic symptoms due to alterations in pain processing by the nervous system, amplifying the perception of pain even without a corresponding painful stimulus.[23] Although there is no direct relationship between DFD and somatic symptoms, nearly half of our sample presented these symptoms with moderate or high intensity, demonstrating the need for their presurgical identification. This understanding is crucial as it directly influences therapeutic approach, replacing interventions aimed solely at minimizing physical discomfort with approaches related to pain processing, such as cognitive and behavioral therapies, specific medications for pain modulation, and strategies to improve function.

To further advance our understanding of the studied variables, anxiety was found to strongly influence the formation of clusters. Psychoemotional aspects play a decisive role in the postoperative period of patients, as well as in their expectations and satisfaction with orthognathic surgery.[24] Anxiety was selected among other psycho-emotional variables because it is highly prevalent in this age group due to the lifestyle of working-age adults.[25] Additionally, anxiety is associated with other emotional conditions and health outcomes, such as painful manifestations[26] and sleep disorders.[27] The report of sleep quality was an important variable in sample stratification. Sleep emerges as an important topic within the health field, with its impact on metabolic and emotional aspects being extensively investigated.[28-30] Several studies have uncovered a segment of the population that experiences poor sleep without recognizing it or underestimates the body's physiological need for rest. Our study population is primarily consisted of working-age patients immersed in academic pursuits, professional responsibilities, and household duties, frequently sacrificing valuable sleep hours.[29,31] This sleep deprivation, in turn, is frequently reported as a symptom, consequence, or common comorbidity of pre-existing anxiety disorders, illustrating a reciprocal relationship where sleep deprivation can exacerbate anxiety.[32] Events such as orthognathic surgery can magnify this bidirectional association, underscoring the surgeon's role in identifying and addressing this scenario when applicable.[33,34] The relationship between sleep and pain is also a complex issue that has undergone extensive research. Initially, a bidirectional relationship was also believed, but studies have failed to establish a clear causal relationship.[35] The expansion of knowledge on this topic has shown that poor quality sleep precedes pain manifestations and plays a significant role in maintaining these conditions. Hence, justifying the vulnerability to muscular TMD in this group.[36] In our study, patients who perceived their sleep as poor or very poor were frequently grouped in the "vulnerable" cluster, while those who rated their sleep as good or very good were more prevalent in the "adaptive" cluster.

Oral behaviors such as SB and AB were tested, and the latter was an important variable in dividing the clusters, being more prevalent in the "vulnerable" cluster. The comprehension of the physiology, diagnostic modalities, and therapeutic strategies for AB is relatively recent and underexplored in this specific population, although it seems to play a crucial role in the postoperative period of orthognathic surgery. Bruxism, particularly AB, is currently recognized as a contributing factor to joint overload and muscle fatigue, thus facilitating the onset and perpetuation of TMD in susceptible individuals.[37] Another point to be explored, for which we still lack concrete data, is the extent to which preoperative anxiety could impact the increase in oral habits.[38] In our study, AB was able to differentiate the individuals in the groups, unlike SB. This result highlights the importance of an approach to raise awareness of daytime habits, as opposed to the use of an interocclusal device which is difficult by

orthodontic appliances or aligners and tooth movements in this population of individuals preparing for orthognathic surgery.

It is noteworthy that despite the high prevalence of joint pain in this sample, its presence was not decisive in defining the clusters. We hypothesize that in these specific individuals, psychological variables, sleep quality, among others mentioned, may not be strongly related to arthralgia. Future research should explore this topic to identify other possible associated variables or even predictors of arthralgia in orthognathic surgery patients. It is important to emphasize that other variables were tested but did not demonstrate as much importance in differentiating the clusters as those described earlier, such as smoking. Smoking, known for its various detrimental effects on oral and systemic health, as well as its association with pain manifestation and intensity, particularly in the chronicity of TMDs.[39] In our study, smoking did not emerge as a strong variable for clustering individuals, possibly due to the low number of participants reporting smoking habits in our sample. The literature shows a relationship between diffuse pain and other pain outcomes.[2,18] In our analysis, we considered the number of painful points on the body and comorbidities such as arthritis, fibromyalgia, and migraine. However, these variables did not prove to be strongly capable of grouping individuals into the population of patients with DFD. We believe this may be attributed to our study population consisting of young adults without primary pain complaints, but rather seeking surgical procedures.

Demographic and facial profile data were explored to elucidate their relationships with the formed clusters. Our initial hypothesis was that Class II patients would present more consistently in the "Vulnerable" grouping. However, no type of DFD showed association with the established clusters. This reinforces the notion that endogenous mechanisms and neuroplasticity play a more significant role in individuals' susceptibility than skeletal or occlusal alterations. Females were significantly related to the Vulnerable Cluster, corroborating literature highlighting women's susceptibility to painful and psychosocial conditions.[2,18] Age showed no correlation with the clusters, which could be explained by the fact that pain conditions more susceptible to temporal factors, such as arthritis, were not explored for cluster formation.

It is important to acknowledge some limitations of this study. Firstly, the sample size was relatively small, which may limit the generalizability of the results to other populations of patients with DFD. Patients with prior treatments for TMD were not excluded. Longitudinal assessment of these patients may also provide valuable insights into the behavior of each cluster postsurgery. Some variables that could influence the clustering of individuals were not tested and offer opportunities for future research, such as mandibular function, somatosensory evaluation, algometry tests, and certain socioeconomic and demographic variables.

Finally, we hope that this initial work will assist healthcare professionals who frequently encounter challenging patients and quickly label them as catastrophic with high levels of psychological symptoms. This approach is detrimental and often empirical, as it is difficult to distinguish the truly relevant findings from the anamnesis and physical examination from those that are not significant for diagnosis. Identifying patients with a vulnerability profile prior to orthognathic surgery guides the surgeon toward a more precise and supportive approach. This reinforces the need for interdisciplinary measures and behavioral modifications to ensure that the pre- and postsurgical stages are less impactful and more predictable in terms of pain.

CONCLUSION

We conclude that patients with DFD seeking orthognathic surgery can be classified into two distinct clusters regarding the presence of painful TMD and associated factors. A "Vulnerable" phenotype, characterized by a higher prevalence of these factors, and an "Adaptive" phenotype, with lower prevalence. The variables that stood out in differentiating these groups were the presence of muscular TMD, signs and symptoms of anxiety, sleep quality, high frequency of AB, and manifestation of somatic symptoms. We emphasize the importance of directing interdisciplinary strategies and behavioral adjustments to minimize discomfort in presurgical orthodontic preparation and postoperative care and to increase the predictability of outcomes, especially in the "Vulnerable" group.

During the preparation of this work, the author(s) used chatgpt.com in order to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

DECLARATIONS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Danielle Veiga Bonotto: Data curation, Formal analysis, Methodology, Writing – original draft. **Jessica Sarah Cavalheiro:** Conceptualization, Data curation, Writing – original draft. **Ramon Targino Firmino:** Formal analysis, Writing – review & editing. **Juliana Stuginski-Barbosa:** Methodology,

Writing – original draft, Writing – review & editing. **Rafaela Scariot:** Conceptualization, Formal analysis, Methodology, Writing – original draft. **Aline Monise Sebastiani:** Conceptualization, Methodology, Supervision, Writing – review & editing.

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9. ANEXO

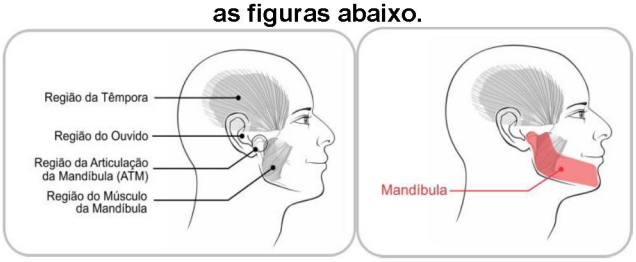
9.1 ANEXO 1

QUESTIONÁRIOS DC/TMD (EIXO II E EIXO II)

Questionário de Sintomas do DC/TMD

Nome do Paciente _____Data _____

Por favor, antes de começarmos o questionário tenha a certeza de que você compreende as figuras abaixo.



Observação: **"Hesitação"** e **"Travamento"** Articular
Indivíduos com uma "hesitação" descreverão este evento como momentâneo e com um impacto mínimo sobre a função e o ritmo dessa função, ou seja, há simplesmente um momento em que a mandíbula para o padrão de movimento programado para em seguida continuar o movimento como se nada tivesse acontecido. "Travamento" é quando o programa de movimento da articulação é completamente interrompido.

DOR

1.	Você já sentiu dor na mandíbula (boca), têmpora, no ouvido ou na frente do ouvido em qualquer um dos lados?	**Não** ☐	**Sim** ☐

Se respondeu NÃO, pule para a Questão 5.

2.	Há quantos anos ou meses atrás você sentiu pela primeira vez dor na mandíbula (boca), têmpora, no ouvido ou na frente do ouvido?	_____anos	_____meses

3.	Nos últimos 30 dias, qual das seguintes respostas descreve melhor qualquer dor que você teve na mandíbula, têmpora, no ouvido ou na frente do ouvido em qualquer um dos lados?	☐ Nenhuma dor
		☐ A dor vem e vai
	Escolha uma resposta.	☐ A dor está sempre presente

Se você respondeu Nenhuma Dor, pule para a Questão 5.

4. Nos últimos 30 dias, alguma das seguintes atividades mudou qualquer dor (isto é, melhorou ou piorou a dor) na sua mandíbula, têmpora, no ouvido ou na frente do ouvido em qualquer um dos lados?

		Não	**Sim**
A.	Mastigar alimentos duros ou resistentes	☐	☐
B.	Abrir a boca ou movimentar a mandíbula para frente ou para o lado	☐	☐
C.	Hábitos ou manias com a mandíbula (boca), como manter os dentes juntos, apertar ou ranger os dentes, ou mastigar chiclete	☐	☐
D.	Outras atividades com a mandíbula (boca) como falar, beijar, bocejar	☐	☐

DOR DE CABEÇA

		Não	Sim
5.	Nos últimos 30 dias, você teve alguma dor de cabeça que incluiu as áreas das têmporas da sua cabeça?	☐	☐

Se você respondeu NÃO para a Questão 5, pule para a Questão 8.

6. Há quantos anos ou meses atrás a sua dor de cabeça na têmpora começou pela primeira vez? _____anos _____meses

7. Nos últimos 30 dias, as seguintes atividades mudaram sua dor de cabeça (isto é, melhorou ou piorou a dor) na região da têmpora em algum dos lados?

		Não	Sim
A.	Mastigar alimentos duros ou resistentes	☐	☐
B.	Abrir a boca ou movimentar a mandíbula para frente ou para o lado	☐	☐
C.	Hábitos ou manias com a mandíbula (boca), como manter os dentes juntos, apertar ou ranger os dentes, ou mastigar chiclete	☐	☐
D.	Outras atividades com a mandíbula (boca) como falar, beijar, bocejar	☐	☐

RUÍDOS ARTICULARES

		Não	Sim	Uso do Pesquisador D	E	Não Sabe
8.	Nos últimos 30 dias, você ouviu algum som ou barulho na articulação quando movimentou ou usou a sua mandíbula (boca)?	☐	☐	☐	☐	☐

TRAVAMENTO FECHADO DA MANDÍBULA

9.	Alguma vez sua mandíbula (boca) travou ou hesitou, mesmo que por um momento, de forma que você não conseguiu abrir ATÉ O FIM?	☐	☐	☐	☐	☐

Se você respondeu NÃO para a Questão 9, pule para a Questão 13.

10.	Sua mandíbula (boca) travou ou hesitou o suficiente a ponto de limitar a sua abertura e interferir com a sua capacidade de comer?	☐	☐	☐	☐	☐
11.	Nos últimos 30 dias, sua mandíbula (boca) travou de tal forma que você não conseguiu abrir ATÉ O FIM, mesmo que por um momento apenas, e depois destravou e você conseguiu abrir ATÉ O FIM?	☐	☐	☐	☐	☐

Se você respondeu NÃO para a Questão 11, pule para a Questão 13.

12.	Nesse momento sua mandíbula (boca) está travada ou com pouca abertura de forma que você não consegue abrir ATÉ O FIM?	☐	☐	☐	☐	☐

				Uso do Pesquisador		
TRAVAMENTO ABERTO DA MANDÍBULA						
13.	Nos últimos 30 dias, quando você abriu bastante a boca, ela travou ou hesitou mesmo que por um momento, de forma que você não conseguiu fecha-la a partir desta posição de ampla abertura? **Se você respondeu NÃO à Questão 13, então você terminou.**	**Não** ☐	**Sim** ☐	**D** ☐	**E** ☐	**Não Sabe** ☐
14.	Nos últimos 30 dias, quando sua mandíbula (boca) travou ou hesitou nesta posição de ampla abertura, você precisou fazer alguma coisa para fecha-la como relaxar, movimentar, empurrar ou fazer algum movimento (manobra) com a boca?	☐	☐	☐	☐	☐

DC/TMD Formulário de Exame

Preencha a data (dd-mm-aaaa) ☐☐-☐☐-☐☐☐☐

Paciente _____ Examinador _____

1a. Local da Dor: Últimos 30 dias (Marque tudo o que se aplica)

DOR NA DIREITA				DOR NA ESQUERDA			
O Nenhum	O Temporal	O Outro M. Mast.	O Estruturas Não-Mast.	O Nenhum	O Temporal	O Outro M. Mast.	O Estruturas Não-Mast.
O Masséter	O ATM			O Masséter	O ATM		

1b. Localização da Cefaléia: Últimos 30 Dias (Marque tudo o que se aplica)

O Nenhum O Temporal O Outra — O Nenhum O Temporal O Outra

2. Relações Incisais — **Dente de Referência** O **FDI #11** O **FDI #21** O **Outro**

Trespasse Horizontal Incisal O Se negativo ☐☐ mm — **Trespasse Vertical Incisal** O Se negativo ☐☐ mm — **Desvio de Linha Média** Direita O Esquerda O N/A O ☐☐ mm

3. Padrão de Abertura-Fechamento (Complementar; Escolha todos que se aplicarem)

O Reto O Desvio Corrigido — Desvio não Corrigido: O Direita O Esquerda

4. Movimentos de Abertura

A. Abertura Sem Dor ☐☐ mm

B. Abertura Máxima Não Assistida ☐☐ mm

C. Abertura Máxima Assistida ☐☐ mm

D. Interrompida? Ⓝ Ⓢ

LADO DIREITO	Dor	Dor Familiar	Cefaleia Familiar
Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

LADO ESQUERDO	Dor	Dor Familiar	Cefaleia Familiar
Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

5. Movimentos Laterais e Protrusivo

A. Lateralidade Direita ☐☐ mm

B. Lateralidade Esquerda ☐☐ mm

C. Protrusão ☐☐ mm

O Se negativo

LADO DIREITO	Dor	Dor Familiar	Cefaleia Familiar
Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

LADO ESQUERDO	Dor	Dor Familiar	Cefaleia Familiar
Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

Temporal	Ⓝ Ⓢ	Ⓝ Ⓢ	Ⓝ Ⓢ
Masseter	Ⓝ Ⓢ	Ⓝ Ⓢ	
ATM	Ⓝ Ⓢ	Ⓝ Ⓢ	
Outros Músc M	Ⓝ Ⓢ	Ⓝ Ⓢ	
Não-mast.	Ⓝ Ⓢ	Ⓝ Ⓢ	

6. Ruídos na ATM Durante os Movimentos de Abertura & Fechamento

ATM DIREITA	Examinador		Paciente	Dor c/	Dor
	Abre	Fecha			
Estalido	N S	N S	N S	N S	N S
Crepitação	N S	N S	N S		

ATM ESQUERDA	Examinador		Paciente	Dor c/	Dor
	Abre	Fecha			
Estalido	N S	N S	N S	N S	N S
Crepitação	N S	N S	N S		

7. Ruídos na ATM Durante os Movimentos Laterais & Protusivo

ATM DIREITA	Examinador		Paciente	Dor c/	Dor
	Abre	Fecha			
Estalido	N S	N S	N S	N S	N S
Crepitação	N S	N S	N S		

ATM ESQUERDA	Examinador		Paciente	Dor c/	Dor
	Abre	Fecha			
Estalido	N S	N S	N S	N S	N S
Crepitação	N S	N S	N S		

8. Travamento Articular

ATM DIREITA	Travamento	Redução	
		Paciente	Examinador
Durante a Abertura	N S	N S	N S
Posição de Abertura Máxima	N S	N S	N S

ATM ESQUERDA	Travamento	Redução	
		Paciente	Examinador
Durante a Abertura	N S	N S	N S
Posição de Abertura Máxima	N S	N S	N S

9. Dor à Palpação dos Músculos & ATM

LADO DIREITO (1 kg)	Dor	Dor Familiar	Cefaleia Familiar	Dor Referida
Temporal (posterior)	N S	N S	N S	N S
Temporal (médio)	N S	N S	N S	N S
Temporal (anterior)	N S	N S	N S	N S
Masseter (origem)	N S	N S		N S
Masseter (corpo)	N S	N S		N S
Masseter (inserção)	N S	N S		N S

ATM	Dor	Dor	Dor
Polo Lateral **(0.5 kg)**	N S	N S	N S
Em volta do Polo Lateral **(1 kg)**	N S	N S	N S

LADO ESQUERDO (1 kg)	Dor	Dor Familiar	Cefaleia Familiar	Dor Referida
Temporal (posterior)	N S	N S	N S	N S
Temporal (médio)	N S	N S	N S	N S
Temporal (anterior)	N S	N S	N S	N S
Masseter (origem)	N S	N S		N S
Masseter (corpo)	N S	N S		N S
Masseter (inserção)	N S	N S		N S

	Dor	Dor	Dor
Polo Lateral **(0.5 kg)**	N S	N S	N S
Em volta do Polo Lateral **(1 kg)**	N S	N S	N S

10. Dor à Palpação em Músculos Acessórios

LADO DIREITO (0.5 kg)	Dor	Dor	Dor
Região posterior da mandíbula	N S	N S	N S
Região submandibular	N S	N S	N S
Região do pterigóideo lateral	N S	N S	N S
Tendão do Temporal	N S	N S	N S

LADO ESQUERDO (0.5 kg)	Dor	Dor	Dor
Região posterior da mandíbula	N S	N S	N S
Região submandibular	N S	N S	N S
Região do pterigóideo lateral	N S	N S	N S
Tendão do Temporal	N S	N S	N S

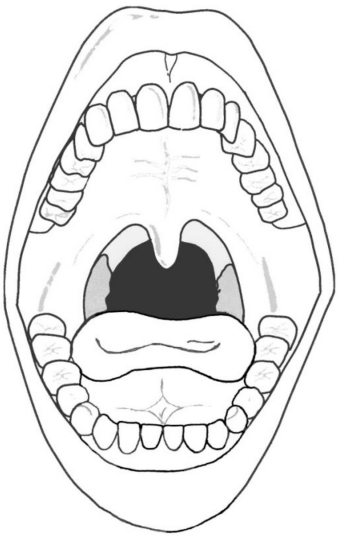
11. Diagnósticos

Desordens de Dor	Desordens da ATM Direita	Desordens da ATM Esquerda
◯ Nenhuma	◯ Nenhuma	◯ Nenhuma
◯ Mialgia	Deslocamento do disco (selecione uma)	Deslocamento do disco (selecione uma)
◯ Dor Miofascial Referida	◯ ... com redução	◯ ... com redução
	◯ ... com redução, com travamento intermitente	◯ ... com redução, com travamento intermitente
◯ Artralgia Direita	◯ ... sem redução, com limitação de abertura	◯ ... sem redução, com limitação de abertura
◯ Artralgia Esquerda	◯ ... sem redução, sem limitação de abertura	◯ ... sem redução, sem limitação de abertura
	◯ Doença degenerativa da articulação	◯ Doença degenerativa da articulação
◯ Dor de cabeça atribuída à DTM	◯ Deslocamento	◯ Deslocamento

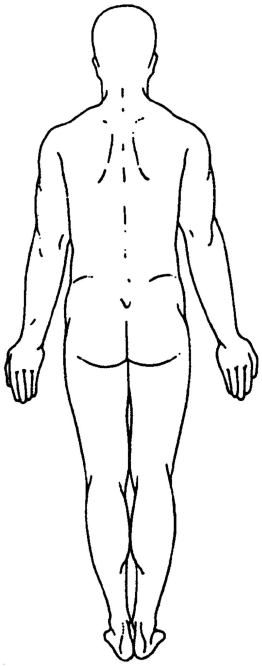
12. Comentários

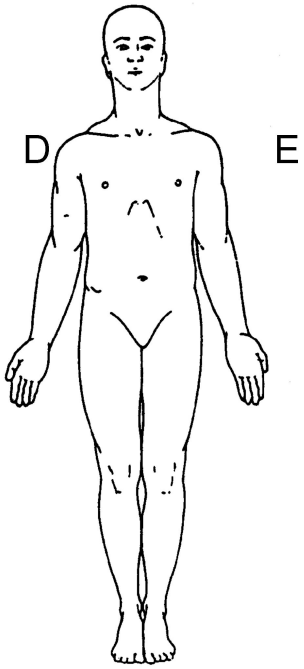
DESENHO DA DOR

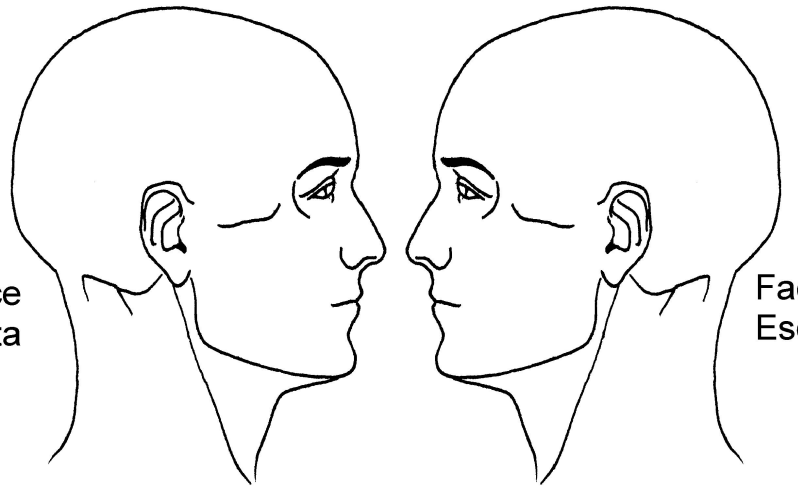
Indique a localização de TODAS as suas diferentes dores sombreando a área, usando os diagramas que são mais relevantes. Se existir um ponto exato onde a dor estiver localizada, indique com um ponto sólido (●). Se sua dor se move de um ponto para outro, use setas para mostrar o caminho.



Boca e Dentes







Face Direita

Face Esquerda

Desordem de Ansiedade Generalizada – 7 (GAD 7)

Durante as <u>últimas 2 semanas</u>, com que frequência você tem se incomodado com os problemas abaixo? Por favor, marque no quadrado para indicar a sua resposta.

	Nenhuma vez	Vários dias	Mais da metade dos dias	Quase todos os dias
	0	1	2	3
1. Sentir-se nervoso(a), ansioso(a) ou irritado(a)	☐	☐	☐	☐
2. Não ser capaz de parar ou controlar suas preocupações	☐	☐	☐	☐
3. Preocupar-se sem necessidade com diversas coisas	☐	☐	☐	☐
4. Dificuldade para relaxar	☐	☐	☐	☐
5. Estar tão agitado(a) que é difícil ficar sentado(a) sem se mexer	☐	☐	☐	☐
6. Se tornar facilmente aborrecido(a) ou irritável	☐	☐	☐	☐
7. Sentir medo como se algo terrível fosse acontecer	☐	☐	☐	☐
SOMA TOTAL =				

Se você marcou <u>algum</u> dos problemas, o quanto esses problemas têm dificultado você para trabalhar, cuidar das coisas de casa, ou se relacionar com outras pessoas?			
Nada difícil	Um pouco difícil	Muito difícil	Extremamente difícil
☐	☐	☐	☐

Questionário de Saúde do Paciente – 15: Sintomas Físicos

Durante as últimas 4 semanas, o quanto você tem se incomodado com os problemas abaixo? Por favor, marque no quadrado para indicar a sua resposta.

	Não incomodou nada	Incomodou um pouco	Incomodou muito
	0	1	2
1. Dor de estômago	☐	☐	☐
2. Dor nas costas	☐	☐	☐
3. Dor nos braços, pernas, ou articulações (joelhos, quadris, etc)	☐	☐	☐
4. Cólicas menstruais ou outros problemas relacionados à sua menstruação [apenas para mulheres]	☐	☐	☐
5. Dores de cabeça	☐	☐	☐
6. Dor no peito	☐	☐	☐
7. Tontura	☐	☐	☐
8. Períodos de desmaios	☐	☐	☐
9. Sentir o seu coração bater forte ou acelerar	☐	☐	☐
10. Falta de ar	☐	☐	☐
11. Dor ou problemas durante a relação sexual	☐	☐	☐
12. Prisão de ventre, intestino solto ou diarréia	☐	☐	☐
13. Náuseas, gases ou indigestão	☐	☐	☐
14. Sentir-se cansado(a) ou com pouca energia	☐	☐	☐
15. Dificuldade de dormir	☐	☐	☐
SOMA TOTAL =			

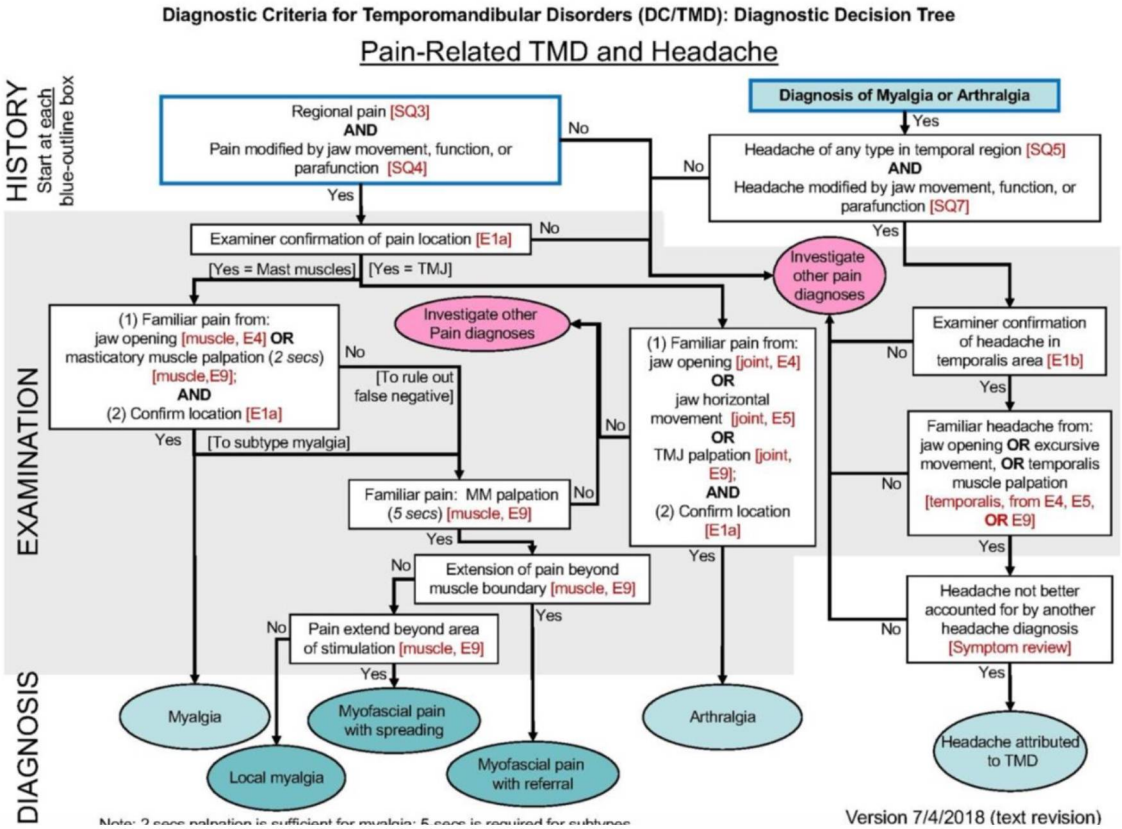
Lista de Verificação dos Comportamentos Orais (OBC)

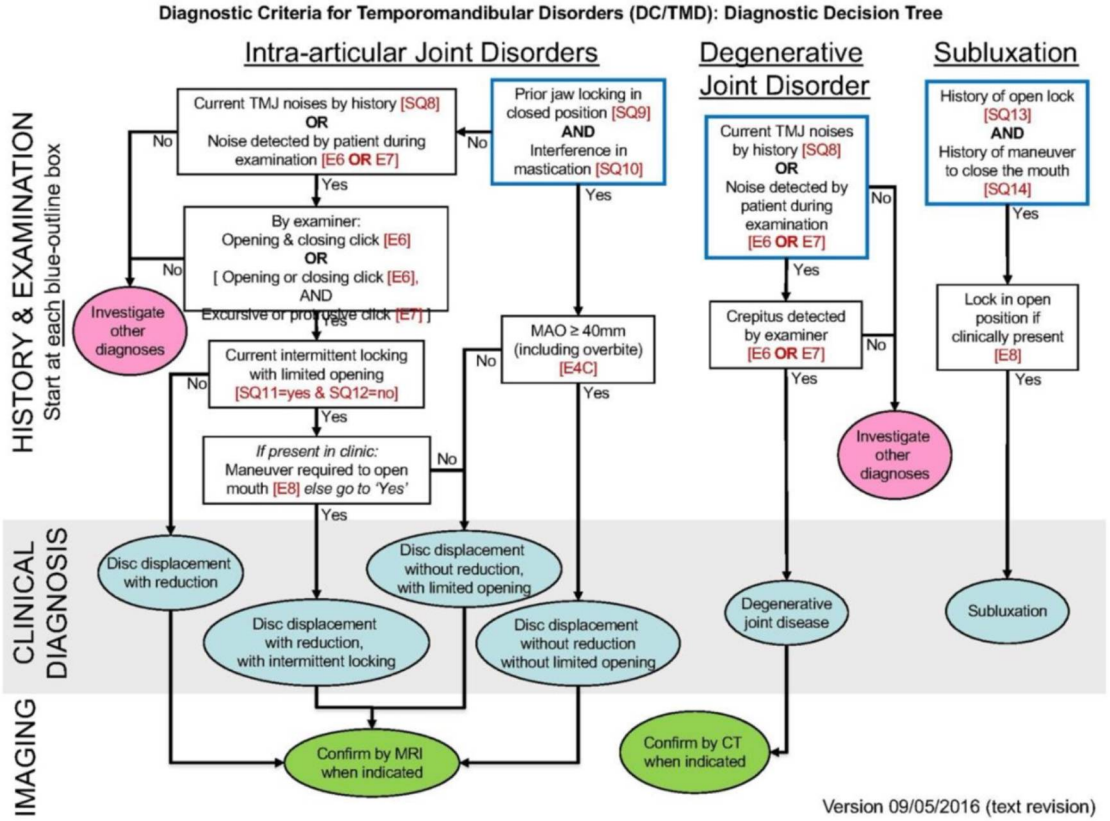
Com qual frequência você fez cada uma das seguintes atividades, baseado no último mês? Se a frequência das atividades variar, escolha a opção mais frequente. Marque (√) uma resposta para cada item e não pule nenhum item. Se você mudar de ideia, preencha a marcação incorreta completamente e, em seguida, marque (√) na nova resposta.

	Atividades durante o sono	**Nenhuma vez**	**<1 noite/ mês**	**1-3 noites/ mês**	**1-3 noites/ semana**	**4-7 noites/ semana**
1	Aperta ou range os dentes **quando está dormindo**, baseado em qualquer informação que você possa ter.	☐	☐	☐	☐	☐
2	Dorme numa posição que coloque pressão sobre a mandíbula (por exemplo, de barriga para baixo, de lado).	☐	☐	☐	☐	☐
	Atividades durante a vigília (acordado)	**Nunca**	**Uma pequena parte do tempo**	**Alguma parte do tempo**	**A maior parte do tempo**	**O tempo todo**
3	Range os dentes **quando está acordado**	☐	☐	☐	☐	☐
4	Aperta os dentes **quando está acordado**	☐	☐	☐	☐	☐
5	Pressiona, toca ou mantém os dentes em contato além de quando está comendo (ou seja, faz contato entre dentes superiores e inferiores).	☐	☐	☐	☐	☐
6	Segura, enrijece ou tensiona os músculos, sem apertar ou encostar os dentes.	☐	☐	☐	☐	☐
7	Mantém ou projeta a mandíbula para frente ou para o lado	☐	☐	☐	☐	☐
8	Pressiona a língua com força contra os dentes	☐	☐	☐	☐	☐
9	Coloca a língua entre os dentes	☐	☐	☐	☐	☐
10	Morde, mastiga, ou brinca com a língua, bochechas ou lábios	☐	☐	☐	☐	☐
11	Mantém a mandíbula em posição rígida ou tensa, tal como para segurar ou proteger a mandíbula	☐	☐	☐	☐	☐
12	Segura entre os dentes ou morde objetos, como cabelo, cachimbo, lápis, canetas, dedos, unhas, etc	☐	☐	☐	☐	☐
13	Faz uso de goma de mascar (chiclete)	☐	☐	☐	☐	☐
14	Toca instrumento musical que envolve o uso da boca ou mandíbula (por exemplo, instrumentos de sopro, metal ou corda)	☐	☐	☐	☐	☐
15	Inclina com a mão na mandíbula, tal como se fosse colocar ou descansar o queixo na mão	☐	☐	☐	☐	☐
16	Mastiga os alimentos apenas de um lado	☐	☐	☐	☐	☐
17	Come entre as refeições (ou seja, alimento que requer mastigação)	☐	☐	☐	☐	☐
18	Fala prolongadamente (por exemplo, ensinando, vendas, atendimento ao cliente)	☐	☐	☐	☐	☐
19	Canta	☐	☐	☐	☐	☐
20	Boceja	☐	☐	☐	☐	☐
21	Segura o telefone entre a cabeça e os ombros	☐	☐	☐	☐	☐

9.2 ANEXO 2

ÁRVORE DE DIAGNÓSTICO DC/TMD.





9.3 ANEXO 3

NORMAS DA REVISTA PARA SUBMISSÃO

ORAL SURGERY, ORAL MEDICINE, ORAL PATHOLOGY AND ORAL RADIOLOGY

2022 Impact Factor: 2.9
Online ISSN: 2212-4411
Print ISSN: 2212-4403
Classificação de Periódicos 2017-2020 (Qualis): A2

GUIDE FOR AUTHORS

Section Scope Statements

The *Oral and Maxillofacial Surgery Section* aims to publish an extensive range of original articles that advances patient care through enhanced understanding of diagnosis, surgical and adjunctive treatment of diseases, and injuries and defects involving both the functional and esthetic aspects of the hard and soft tissues of the oral and maxillofacial regions. The section also seeks research regarding both the basic science of and management of persons with oral and maxillofacial conditions. Articles presenting ethical, original, well-documented, and reproducible research are given preference.

The *Oral Medicine Section* aims to publish a broad range of original articles that help clinicians understand more thoroughly the pathobiology, etiology, diagnosis, prevention, and management of oral conditions related to underlying medical conditions, including diseases of the head, neck, and oral mucosal structures, orofacial pain conditions, salivary gland disorders, and taste disorders. The section also seeks research regarding the dental management of persons with medical problems and/or complicated medical conditions. The published findings must contribute substantively to the body of oral medicine literature and should lead to improved clinical decision-making and enhanced care of medically-related disorders or conditions affecting the oral and maxillofacial region. Articles presenting original, well-documented, and reproducible research are preferred.

The *Oral and Maxillofacial Pathology Section* encourages the submission of original articles of high scientific quality that investigate the pathogenesis, diagnosis, and management of diseases affecting the oral and maxillofacial region. Submitted manuscripts may summarize findings from clinical, translational, or basic research in the broad field of oral and maxillofacial pathology but must contribute substantively to the body of knowledge in this field and should be of obvious clinical and/or diagnostic significance to the practicing oral and maxillofacial pathologist. Areas of focus may include the investigation of disease pathogenesis, the diagnosis of disease using microscopic, clinical, radiographic, biochemical, molecular, or other methods as well as the natural history and management of patients with various conditions of the head, neck, and oral mucosal structures. Diagnostic accuracy studies should conform to the principles of the STARD document http://www.stard-statement.org. Articles presenting novel and reproducible research that introduce new knowledge and observations are especially encouraged. This section also80 welcomes the submission of topical review papers on relevant subjects.

The *Oral and Maxillofacial Radiology Section* publishes original contributions to the advancement of oral and maxillofacial radiology and related imaging sciences. The section considers original clinical and experimental research papers, reports of technological developments, extensive systematic reviews of the literature, and invited papers on subjects that will appeal to researchers and clinicians involved in diagnostic imaging of hard and soft tissues of the head and neck. Topics of interest include the efficacy of imaging systems using ionizing and non-ionizing radiation in the diagnosis of head and neck disease; molecular imaging; artificial intelligence and computer-assisted diagnosis; craniofacial analysis; image-guided surgical navigation; image processing; radiation physics and dosimetry; and radiation biology, safety, and protection. The section also seeks extensive case series representing various expressions of particular conditions, descriptions of innovative

imaging technique applications to these series, and description of novel imaging features. Published manuscripts should assist clinicians in developing evidence-based practice and provide improved clinical decision-making regarding the performance of specific techniques and interpretation of resulting images. Diagnostic accuracy studies should conform to the principles of the STARD document http://www.stard-statement.org).

Types of Papers

1. Original Research Article. Reports of original research (preclinical, clinical, or translational) that are well-documented, novel, and significant. Original research manuscripts will be organized into six parts: (1) Abstract; (2) Introduction; (3) Materials and Methods; (4) Results; (5) Discussion; (6) References.
2. Review article. Manuscripts that review the current status of a given topic, diagnosis, or treatment. These manuscripts should not be an exhaustive review of the literature but rather should be a review of contemporary thought with respect to the topic. Systematic reviews and meta-analyses manuscripts should follow PRISMA (http://www.prisma-statement.org) and the Institute of Medicines' guidelines (http://www.iom.edu/Reports/2011/Finding-What-Works-in-Health-Care-Standards-for-Systematic-Reviews/Standards.aspx).
3. Clinicopathologic Conference (CPC). Manuscripts that document interesting, challenging, or unusual cases that present unexpected or interesting diagnostic challenges. The presentation should simulate clinical work-up, including the formulation of a detailed and well thought out differential diagnosis. The complete diagnostic evaluation, management, and follow-up must be included. CPC articles must be organized into six parts: (1) Title: Provide a descriptive clinical title that does not reveal the final diagnosis. (2) Clinical presentation: Describe the clinical and imaging characteristics of the lesion. Use clinical photographs and radiographs as appropriate. (3) Differential diagnosis: List and discuss lesions to be considered as reasonable diagnostic possibilities. The authors are reminded that the most important part of the CPC manuscript is the clinical differential diagnosis, where the authors guide the readership through their own diagnostic thought process. This will require the formulation of a list of the most probable diagnostic possibilities (ideally at least 5-6 entities) based on the clinical presentation, medical history, and/or radiographic studies. (4) Diagnosis: Histopathologic findings illustrated with appropriate photomicrographs. (5) Management: Describe the treatment of the81 patient and response to treatment. (6) Discussion: Concentrate on the most interesting aspect(s) of the case. No abstract is needed for CPC manuscripts. Limit the number of references to no more than 25.
4. Case Reports. These types of publications often add little to the scientific knowledge base. However, excellent case reports may be published as online only papers if they meet certain criteria, such as: (1) rare or unusual lesions/conditions that need documentation, (2) well-documented cases showing unusual or "atypical" clinical or microscopic features or behavior, or (3) cases showing good long-term follow-up information, particularly in areas in which good statistics on results of treatment are needed. A case report should either present unique features of the condition or lesion, novel treatment regimens, or provide the basis for a new plausible medical theory about the pathogenesis of a particular disease or condition so clinicians can provide better care regarding patients with chronic and painful conditions relevant to medical disorders and/or medical therapy. Providing Virtual Microscope image/s is highly encouraged for Case Reports (see also below). Enhancements such as Virtual Microscope images, DICOM files, and video clips are not mandatory for initial submission but are encouraged for all article types; if editors request a revision, they may specifically request submission of these types of files with the revised manuscript.

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BEFORE YOU BEGIN

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Reporting sex- and gender-based analyses

Reporting guidance

For research involving or pertaining to humans, animals or eukaryotic cells,84 investigators should integrate sex and gender-based analyses (SGBA) into their research design according to funder/sponsor requirements and best practices within a field. Authors should address the sex and/or gender dimensions of their research in their article. In cases where they cannot, they should discuss this as a limitation to their research's generalizability. Importantly, authors should explicitly state what definitions of sex and/or gender they are applying to enhance the precision, rigor and reproducibility of their research and to avoid ambiguity or conflation of terms and the constructs to which they refer (see Definitions section below). Authors can refer to the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER guidelines checklist. These offer systematic approaches to the use and editorial review of sex and gender information in study design, data analysis, outcome reporting and research interpretation - however, please note there is no single, universally agreed-upon set of guidelines for defining sex and gender.

Definitions

Sex generally refers to a set of biological attributes that are associated with physical and physiological features (e.g., chromosomal genotype, hormonal levels, internal and external anatomy). A binary sex categorization (male/female) is usually designated at birth (""sex assigned at birth""), most often based solely on the visible external anatomy of a newborn. Gender generally refers to socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each other, how they behave and interact and how power is distributed in society. Sex and gender are often incorrectly portrayed as binary (female/male or woman/man) and unchanging whereas these constructs actually exist along a spectrum and include additional sex categorizations and gender identities such as people who are intersex/have differences of sex development (DSD) or identify as non-binary. Moreover, the terms

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