UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

PATRICIA NADELMAN

CONSEQUÊNCIAS DA PERDA/EXTRAÇÃO PRECOCE DE DENTE(S) DECÍDUO(S) ANTERIOR(ES) EM BEBÊS E CRIANÇAS.

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Tese de Doutorado apresentada ao Programa de Pós-graduação em Odontologia (área de concentração: Odontopediatria), Faculdade de Odontologia, Universidade Federal do Rio de Janeiro, como requisito parcial à obtenção do título de Doutor em Odontologia (área de concentração: Odontopediatria).

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Aprovada em 27/03/2023

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Ata de Defesa de Tese para a concessão do grau de Doutor em Odontologia, Área de Concentração em Odontopediatria

Aos vinte e sete dias do mês de março do ano de dois mil e vinte e três, às 09 horas, reuniu-se no Anfiteatro I da FO-UFRJ, a Banca Examinadora da Defesa de Tese da aluna **Patricia Nadelman,** do Programa de Pós-graduação Stricto Sensu (Acadêmico) em Odontologia, da Faculdade de Odontologia da Universidade Federal do Rio de Janeiro. A Banca Examinadora foi constituída pelas Professoras Lucianne Cople Maia de Faria (Presidente da Banca e Membro Titular Interno), Antônio Carlos de Oliveira Ruellas (Membro Titular Interno), Andréa Vaz Braga Pintor (Membro Titular Interno), Rogério Gleiser (Membro Titular Externo) e Michele Machado Lenzi da Silva (Membro Titular Externo). O trabalho de tese teve como título **"Consequências da perda/extração precoce de dente(s) decíduo(s) anterior(es) em bebês e crianças"** e foi orientado pelos professores Lucianne Cople Maia de Faria, Amanda Cunha Regal de Castro e Matheus Melo Pithon. A candidata fez a exposição de sua tese em 30 minutos e após, foi arguida oralmente pelos membros da comissão, tendo como resultado:

( ) Aprovação da tese sem restrições.

(X) Aprovação da tese condicionada ao cumprimento de exigências feitas pela comissão (com prazo máximo de 90 dias).

( ) Reprovação da tese.

Na forma regulamentar, foi lavrada a presente ata, que segue assinada pelo presidente da Comissão Julgadora, demais membros presentes e pelo (a) candidato(a). A presidente da Comissão assina a ata pelo membro que participou remotamente da sessão.

Rio de Janeiro, 27 de março de 2023.

Lucianne Cople Maia de Faria
(Presidente da Banca)

Rogério Gleiser
(Membro Titular Externo da Banca)

Antônio Carlos de Oliveira Ruellas
(Membro Titular Interno da Banca)

Michele Machado Lenzi da Silva
(Membro Titular Externo da Banca)

Andrea Vaz Braga Pintor
(Membro Titular Interno da Banca)

Patrícia Nadelman
candidata

Dedico esse trabalho à UFRJ que me acolheu nos últimos 13 anos.

Sempre sonhei em estudar na Federal do Rio de Janeiro.

O sonho era tão grande, que a ansiedade tomou conta de mim e quase não passei no vestibular em 2009. Para minha surpresa, lá estava meu nome, em último lugar da lista de classificação para Odontologia. Mal sabia que aquele era o início de uma longa história repleta de aprendizados, amadurecimento e realizações.

Durante a Graduação, conheci as disciplinas de Odontopediatria e Ortodontia. Foi amor à primeira vista. O Departamento de Odontopediatria me recebeu de braços abertos. Fiz todas as matérias possíveis de Odontopediatria na Graduação, segui com a Especialização, emendei no Mestrado e hoje defendo minha tese de Doutorado unindo as duas disciplinas pelas quais tenho tanto amor.

Na UFRJ realizei a melhor formação possível e, nela vivi inúmeros momentos importantes, tanto da minha vida profissional quanto pessoal. Encerro minha jornada acadêmica com o coração apertado mas muito realizada com os frutos gerados nesses últimos anos e com a profissional que me tornei.

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“A satisfação está no esforço e não apenas na realização final.” (Mahatma Gandhi)

RESUMO

NADELMAN, Patricia. **Consequências da perda/extração precoce de dente(s) decíduo(s) anterior(es) em bebês e crianças.** Rio de Janeiro, 2023. Tese (Doutorado em Odontologia – Área de concentração: Odontopediatria) – Faculdade de Odontologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2023.

Avaliaram-se consequências da perda precoce de dentes decíduos anteriores por meio de três fases. Na 1ª, realizou-se levantamento da evidência científica disponível por meio de revisão sistemática e meta-análise (RS), revisão crítica da literatura (RC) e e-book. A RS foi dividida em seleção dos artigos, extração de dados, risco de viés, meta-análise e certeza da evidência; na RC, realizou-se compilação dos dados e análise crítica. Por fim, as informações foram organizadas em e-book com fins educativos. Na 2ª, realizaram-se dois estudos (Es) de concordância e reprodutibilidade, para avaliar instrumentos em modelos de estudo (Es1) e na clínica (Es2). No Es1, dois avaliadores treinados e calibrados realizaram mensurações diretamente com paquímetro digital e compasso de pontas secas em 40 modelos de gesso de bebês/crianças com idade entre 1 e 5 anos, com e sem perdas dentárias, comparados à medidas digitais feitas em software pós escaneamento 3D. Foram avaliadas 6 medidas dentárias lineares (MDL): espaço mésio-distal da perda dentária (EPD) (se houvesse), perímetro do arco, comprimento do arco, largura do arco, comprimento intercaninos e largura intercaninos. O Es2 comparou paquímetro digital e compasso de pontas secas para mensuração clínica do EPD realizada por dois operadores independentes em 15 bebês/crianças com idade entre 2 a 6 anos. Na 3ª, estudo longitudinal de coorte avaliou consequências da perda precoce anterior nos arcos dentários e no desenvolvimento da oclusão de outros 15 bebês/crianças de 1 a 5 anos comparados à bebês/crianças sem perdas dentárias após 24 meses de acompanhamento. Foram realizados exame de oclusão, mensuração clínica do EPD com paquímetro digital e documentação com fotografias intrabucais e confecção de modelos de estudo pela impressão dos arcos. Essas etapas foram realizadas no tempo zero (T0) e repetidas após 24 meses (T1). Os modelos foram escaneados em *scanner* ótico 3D e realizaram-se MDL em software digital. As medidas digitais foram repetidas após 1 mês para avaliação do erro do método. A análise estatística de cada fase foi

desenvolvida individualmente utilizando: coeficiente de correlação intraclasse (CCI), Bland-Altman, teste-t, Shapiro-Wilk e teste de Levene's, adotando nível de significância de 0,05%. Dos estudos selecionados na meta-análise (n=4), verificou-se que crianças que perderam dentes decíduos anteriores apresentaram maior chance de sofrer distorção da fala do que crianças sem perdas com baixa certeza de evidência (OR 5,466 [1,689, 17,692] p=0,005). Por outro lado, não houve diferença estatística entre esta perda e omissão ou substituição de fonemas, ambos com muito baixa certeza de evidência. Com relação ao Es1, o CCI inter-examinador foi considerado excelente variando de 0,93 a 1,00 e a concordância entre os instrumentos foi boa com média da diferença variando de -0,034mm (-1,077; 1,145) a -1,002mm (-2,632; 0,627). No Es2, o CCI inter-examinador também foi excelente com valor médio de 0,99 e houve concordância entre os instrumentos. No estudo de coorte, não houve diferença clínica significativa no EPD (p=0,938). Valores CCI intra-examinador foram variaram de 0,73 a 1,00. A precisão do método foi adequada, sem evidência de viés de proporção. Não houve diferenças estatisticamente significativas nas MDL tanto do grupo exposto quanto do não-exposto (p>0,05). Alterações nos arcos dentários e no desenvolvimento da oclusão puderam ser evidenciadas por meio da análise descritiva, incluindo: esfoliação e erupção de dentes decíduos, erupção de dentes permanentes, autocorreção e estabelecimento de maloclusões, entre outros. A presente tese concluiu que a perda precoce anterior pode causar distorção da fala, com baixa certeza de evidência. Demonstrou que MDL podem ser realizadas com boa concordância e reprodutibilidade em modelos de gesso com paquímetro digital e compasso de pontas secas e em modelos digitais com software. Demonstrou que, paquímetro digital e compasso de pontas secas podem ser utilizados com boa concordância e reprodutibilidade para mensuração clínica do EPD. Por fim, não houve diferenças nos arcos dentários e no desenvolvimento da oclusão de bebês/crianças com perda precoce anterior em comparação aos sem perdas. Entretanto, alterações fisiológicas e patológicas foram diagnosticadas clinicamente em ambos os grupos, destacando a importância da análise clínica e qualitativa.

Palavras-chave: Dente decíduo; incisivo; dente canino; perda de dente; oclusão dentária; fonação.

ABSTRACT

NADELMAN, Patricia. **Consequências da perda/extração precoce de dente(s) decíduo(s) anterior(es) em bebês e crianças.** Rio de Janeiro, 2023. Tese (Doutorado em Odontologia – Área de concentração: Odontopediatria) – Faculdade de Odontologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2023.

Consequences of premature loss of primary anterior teeth were evaluated through three phases. In 1st, a survey of available scientific evidence was conducted through systematic review and meta-analysis (SR), critical literature review (CR), and e-book development. SR was divided into article selection, data extraction, risk of bias, meta-analysis, and certainty of evidence; while CR was composed by data compilation and critical analysis. Finally, all data were organized into an e-book for educational purposes. In 2nd, two studies (S) of agreement and reproducibility were performed to evaluate measurement instruments in study models (S1) and in the clinic (S2). In S1, two trained and calibrated operators performed dental linear measurements (DLM) with compass and digital caliper directly on 40 plaster models of infants/children aged from 1 to 5 years old, with and without tooth losses, compared to digital measurements made in software after 3D scanning. Two trained and calibrated operators measured models with compass, digital caliper, and digital software. Six DLM were evaluated: missing tooth space (MTS) (if any), arch perimeter, arch length, arch width, intercanine length and intercanine width. S2 compared compass and digital caliper for clinical measurement of MTS in 15 infants/children aged between 2 and 6 years old. In 3rd, a longitudinal observational cohort study was conducted to evaluate consequences of premature anterior loss on dental arches and occlusion development in 15 infants/children aged 1 to 5 years compared to participants without teeth losses. Occlusion examination was performed, MTS measurement with digital caliper, and recording through intraoral photographs and study models preparation by impression of upper and lower arches. These steps were performed at baseline (T0) and repeated after a minimum of 24 months (T1). The models were scanned with a 3D optical scanner and DLM were performed with digital software. All digital measurements were repeated after 1 month to evaluate method error. Statistical analysis of each phase was individually

developed using: intraclass correlation coefficient (ICC), Bland-Altman, t-test, Shapiro-Wilk and Levene's test, adopting a significance level of 0.05%. From the studies selected in meta-analyses (n = 4), it was found that children who lost primary anterior teeth had a greater chance of suffering speech distortion than children without tooth loss with low certainty of evidence (OR 5.466 [1.689, 17.692] p=0.005). On the other hand, there was no statistical difference between tooth loss and phoneme omission and substitution, both with very low certainty of evidence. Regarding E1, inter-rater ICC was considered excellent varying from 0.93 to 1.00 and agreement between the instruments was good, varying from 0.034mm (-1.077; 1.145) a -1.002mm (-2.632; 0.627). In E2, inter-rater ICC was also considered excellent with mean value being 0.99 and there was no statistically significant difference between the instruments, also indicating agreement, regardless of the operator. In cohort study, there was no significant change in clinical MTS measurement (p = 0.938). ICC values ranged from 0.73 to 1.00. Method accuracy was adequate and there was no evidence of proportion bias. There were no statistically significant changes in DLM of both exposed and non-exposed groups (p>0.05). Changes in dental arches and occlusion development were evidenced by descriptive analysis, including: exfoliation and eruption of primary teeth, eruption of permanent teeth, self-correction and establishment of malocclusion, among others. In this thesis, it was concluded that premature loss of primary anterior teeth could cause speech distortion, with low certainty of evidence. It was shown that DLM could be performed with good agreement and reproducibility both on plaster models with compass and digital caliper, and on digital models with software. It was also demonstrated that both compass and digital caliper could be used with good agreement and reproducibility for MTS measurements. Finally, there were no statistically changes in dental arches and occlusion development of infants and children with premature loss of primary anterior teeth compared to those without losses. However, physiological and pathological changes were clinically diagnosed in both groups, highlighting the importance of clinical follow-up and descriptive analysis.

Key-words: Tooth, Deciduous; incisor; cuspid; tooth loss; dental occlusion; phonation.

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LISTA DE ABREVIATURAS E SIGLAS

3D	Três dimensões
AJODO	American Journal of Orthodontics and Dentofacial Orthopedics
BBO	Bibliografia Brasileira de Odontologia
C	Controle/control
CAAE	Certificado de Apresentação de Apreciação Ética
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
CCI	Coeficiente de correlação intraclasse
CI	Confidence interval
CNPq	Conselho Nacional de Desenvolvimento Científico Tecnológico
COVID-19	Coronavirus Disease 2019
CVMT	Centro de Vigilância e Monitoramento de Traumatismos Dentários
DIF	Difference
DLM	Dental linear measurements
Dr/ Drª	Doutor/ Doutora
Es	Estudo
E	Exposição/exposition
E-book	Electronic book
e-mail	Electronic mail
EPD	Espaço da perda dentária
Es1/ Es2	Estudo 1/ Estudo 2
et al.	E outros, do latim et alia
EUA	Estados Unidos da América
FAPERJ	Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro
FO	Faculdade de Odontologia
GRADE	Grading Recommendations, Assessments, Development, and Evaluations
HUCFF	Hospital Universitário Clementino Fraga Filho
I^2	Heterogeneidade
IAPD	International Association of Paediatric Dentistry
IC	Intervalo de confiança

ICC	Intraclass correlation coefficient
ICE	Instrumentos Cirúrgicos Esmeralda
Inc	Incorporated
Lilacs	Literatura Latino-Americana e do Caribe em Ciências da Saúde
Ltda	Limitada
MDL	Medidas dentárias lineares
MeSH	Medical Subject Headings
mm	Milímetro/ Millimeter
MTS	Missing tooth/teeth space
n	Número absoluto
Nº	Number
NA	Not applicable
NR	Not reported
O	Desfecho/outcome
OR	Odds ratio
P	População/population
PhD	Philosophy Doctor
PPGO	Programa de Pós-Graduação em Odontologia
Prof/Profª	Professor/ Professora
PubMed	PubMed Unique Identifier
QR Code	Quick response code
r^2	Coeficiente de determinação
RC	Revisão crítica
RevMan	Review Manager
RJ	Rio de Janeiro
RR	Risco relativo/ Relative risk
RS	Revisão sistemática
S	Study
S1/S2	Study 1/ Study 2
SD	Standard deviation
SPSS	Statistical Package for the Social Sciences
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
T0	Tempo 0/ Timepoint 0
T1	Tempo 1/ Timepoint 1

TCLE	Termo de Consentimento Livre e Esclarecido
TDI	Traumatic dental injuries
UFRJ	Universidade Federal do Rio de Janeiro
USA	United States of America
VHL	Virtual Health Library

LISTA DE SÍMBOLOS

ª	Numeral ordinal
st, nd, rd	Ordinal indicator
®	Marca Registrada
α	Alfa
%	Por cento
X	Vezes
±	Mais ou Menos
=	Igual
-	Menos
<	Menor que
>	Maior que
≤	Menor ou igual a

SUMÁRIO

1 INTRODUÇÃO

A orientação da erupção e desenvolvimento da dentição decídua é parte integrante das áreas de Odontopediatria e Ortodontia. Esta orientação contribui para o desenvolvimento da dentição permanente com uma oclusão estável e harmônica. A supervisão apropriada e a identificação de anormalidades na dentição em desenvolvimento são de extrema importância para o diagnóstico precoce, prognóstico adequado e para o sucesso do tratamento, quando este se fizer necessário (MC DONALD; AVERY; DEAN, 2011).

A dentição decídua apresenta fundamental importância morfológica, funcional e psicossocial para a criança, auxiliando no crescimento e desenvolvimento adequado dos ossos e musculatura facial, mastigação, deglutição, fonação e estética (BROTHWELL, 1997). Além disso, os dentes decíduos também mantêm a integridade dos arcos dentários, conservando o perímetro, comprimento e largura dos arcos e, com isso, preservando o espaço para erupção dos dentes sucessores permanentes (THUROW, 1977).

O período de erupção dos dentes decíduos na cavidade bucal estende-se, em média, dos 6 meses aos 2,5 anos de idade. No momento em que a dentição decídua se apresenta completa, uma avaliação morfológica da oclusão pode ser realizada, a fim de determinar a normalidade ou presença de irregularidades (SILVA FILHO; GARIB, 2013).

Idealmente, uma sequência de eventos ordenados deve ocorrer durante o desenvolvimento da dentição decídua estabelecendo uma oclusão funcional, estética e estável (SILVA FILHO; GARIB, 2013). Entretanto, fatores internos e externos podem interromper esta sequência, desencadeando o surgimento de maloclusões que podem afetar tanto a dentição decídua quanto o período misto da dentição e a dentição permanente (MC DONALD; AVERY; DEAN, 2011). A compreensão da etiologia dessas maloclusões permite avaliar o prognóstico de tais irregularidades (SILVA FILHO; GARIB, 2013).

Mossey (1999-a, 1999-b) classificou os fatores etiológicos das maloclusões como fatores genéticos e ambientais. Os fatores genéticos são condições inerentes ao indivíduo, entre as quais predominam a influência da genética e da hereditariedade. Enquanto os fatores ambientais são elementos externos ao sujeito,

predominando a influência do meio ambiente ou do modo de vida. Dentre os fatores etiológicos essencialmente ambientais, a perda ou extração prematura de dentes decíduos pode ser destacada.

Esta perda ou extração prematura é definida como a ausência de um dente temporário enquanto o sucessor permanente ainda não se encontra em estágio adequado de erupção (PEDERSEN; STENSGAARD; MELSEN, 1978). A perda é considerada prematura quando ocorre pelo menos 1 ano antes de sua esfoliação normal ou enquanto o dente sucessor permanente ainda encontra-se antes do estágio seis de Nolla, evidenciado pelo exame radiográfico, no qual a formação coronária está completa e a raiz está com menos de 2/3 de formação (NOLLA, 1960; SANTOS et al., 2013). Pode acometer tanto a região anterior quanto a posterior dos arcos. A etiologia mais comum da perda precoce de dentes decíduos posteriores está associada à cárie dentária (BROTHWELL, 1997; NGAN; ALKIRE; FIELDS, 1999). Enquanto que, a perda prematura de dentes anteriores ocorre principalmente devido à cárie da primeira infância e ao traumatismo dento-alveolar (MALMGREN et al., 2012).

A cárie na primeira é definida como a presença de uma ou mais superfícies cariadas (cavitada ou não cavitada), perdidas ou restauradas (devido à cárie) em qualquer dente decíduo de uma criança com menos de seis anos de idade (PITS et al., 2019). Clinicamente essa condição acomete mais os incisivos, seguido dos primeiros molares, caninos e segundos molares, de acordo com a cronologia de erupção dentária. Apesar de ser uma doença que pode ser evitada ou controlada, a cárie ainda é considerada um problema de saúde pública global que atinge inúmeras pessoas em qualquer faixa etária, sendo mais predominante em crianças em idade pré-escolar, menos favorecidas (PHANTUMVANIT et al., 2017). Lesões de cárie não-tratadas podem levar à perda precoce dos dentes decíduos acometidos (MC DONALD; AVERY; DEAN, 2011).

Esta perda dentária anterior causada por traumatismo pode ser resultado de uma avulsão; extração após injúria devido ao mau prognóstico; complicações tardias; ou esfoliação precoce por causa da reabsorção acelerada da raiz do dente decíduo (CARDOSO; ROCHA, 2008; ARIKAN; SARI; SONMEZ, 2010; RASMUSSON; KOCH, 2010). Além disso, a extração de incisivos e caninos decíduos traumatizados pode se fazer necessária por incapacidade de aceitação do

tratamento pela criança ou pela rejeição dos responsáveis pelo tratamento para mantê-los na arcada (HOLAN; NEEDLEMAN, 2014).

As sequelas resultantes desta perda prematura dividem opiniões. Silva Filho & Garib (2013) acreditam que as consequências da perda precoce de incisivos decíduos se limitam principalmente à estética e função relacionada à fala e à deglutição. Sabe-se que os dentes anteriores desempenham papel fundamental na produção de determinados sons da fala. Consequentemente, a perda deles pode prejudicar a pronúncia de certos fonemas (por exemplo, “f”, “s”, “v” e “z”), uma vez que, sua articulação correta envolve o toque da língua ou do lábio nos incisivos superiores (LAMBERGHINI et al., 2012).

Por outro lado, Holan & Needleman (2014) consideram que além destas consequências, a perda precoce de dentes decíduos anteriores também poderia afetar negativamente a qualidade de vida; causar perda de espaço nos arcos dentários pela migração e inclinação de dentes adjacentes ao espaço edêntulo; prejudicar o desenvolvimento e erupção do dente sucessor permanente; deflagrar problemas no alinhamento dos dentes permanentes pelo comprometimento da integridade do arco; e, ainda influenciar no surgimento de hábitos não-nutritivos.

Para McDonald, Avery & Dean (2011), a perda precoce de incisivos decíduos superiores e/ou inferiores pode resultar na perda de espaço anterior, caso essa perda ocorra anterior a erupção do canino decíduo. Ademais, outros fatores também poderiam influenciar na perda de espaço, tais como o tipo de arco dentário decíduo de Baume (BAUME, 1950), a presença de hábitos não-nutritivos, a quantidade de dentes perdidos, entre outros. Se os dentes decíduos anteriores estiverem em íntimo contato anteriormente à perda (arco tipo II de Baume, por exemplo), ou se houver evidência de inadequação do comprimento do arco na região anterior, os ajustes de espaço no alinhamento após a perda de um dos incisivos constituem um fator potencial para a perda de espaço.

Apesar das ponderações relatadas acima, ainda há escassez de evidência científica robusta disponível na literatura acerca das consequências morfológicas e funcionais da perda precoce de dentes decíduos anteriores. Com relação à alterações morfológicas nos arcos dentários decíduos, apenas um estudo clínico com metodologia adequada é encontrado na literatura avaliando a perda de espaço no perímetro do arco após perda ou extração prematura de incisivos e caninos

decíduos, e o mesmo reporta inexistência na redução do espaço (CLINCH; HEALY, 1959). À respeito das consequências funcionais, os poucos estudos encontrados na literatura (RIEKMAN; ELBADRAWY, 1985; GABLE et al., 1995; ADEWUMI et al., 2012; LAMBERGHINI et al., 2012) que avaliam o efeito da perda precoce anterior na fonação, relatam que crianças que perderam incisivos decíduos superiores precocemente podem apresentar algum prejuízo na fala, principalmente, na articulação de palavras contendo “s” e “z”.

Contudo, os artigos disponíveis sobre as consequências da perda ou extração precoce de incisivos e caninos decíduos ainda são escassos. Considerando-se a relevância do assunto em questão, o presente estudo foi desenvolvido e dividido em 3 fases objetivando: 1ª fase (teórica) – compilar, avaliar e organizar as evidências científicas disponíveis na literatura acerca da etiologia, das características, das consequências e das possíveis intervenções para a perda prematura de dentes anteriores decíduos; 2ª fase (prática) – avaliar diferentes instrumentos para mensurações dentárias e dos arcos dentários em modelos de estudo e diretamente na cavidade bucal, a fim de padronizar a metodologia e facilitar o desenvolvimento de estudos clínicos futuros; 3ª fase (clínica) – avaliar, longitudinalmente, as modificações e evolução dos arcos dentários e desenvolvimento da oclusão de bebês/crianças de 0 a 6 anos que apresentaram perda ou extração precoce de um ou mais dentes decíduos anteriores em decorrência de traumatismo dento-alveolar comparando com bebês/crianças sem perdas dentárias, por meio de um estudo do tipo coorte.

2 PROPOSIÇÃO

2.1 OBJETIVO GERAL

Avaliar as evidências científicas disponíveis, os instrumentos de medição e as consequências da perda ou extração precoce de incisivo(s) e canino(s) decíduo(s) nos arcos dentários e no desenvolvimento da oclusão de bebês e crianças de 0 a 6 anos.

2.2 OBJETIVOS ESPECÍFICOS – 1ª FASE

- Realizar um levantamento de todas as evidências científicas disponíveis na literatura e compilar os dados coletados sobre as consequências da perda precoce de dentes decíduos anteriores.
- Avaliar por meio de uma revisão sistemática da literatura e meta-análise as consequências da perda precoce de dentes decíduos anteriores na integridade do arco e na fala de bebês e crianças expostas à perda em comparação com bebês e crianças não-expostas.
- Apresentar e discutir, por meio de uma revisão crítica da literatura, as evidências disponíveis sobre etiologia, características, implicações e possíveis intervenções após a perda precoce de dentes decíduos anteriores.
- Desenvolver um livro digital (e-book), a fim de orientar alunos de Odontologia, cirurgiões-dentistas recém-formados e clínicos quanto ao diagnóstico, decisão terapêutica e tratamento, propriamente dito, da perda precoce de dentes decíduos anteriores.

2.3 OBJETIVOS ESPECÍFICOS – 2ª FASE

- Comparar instrumentos de medição analógico (compasso de pontas secas), analógico com mostrador digital (paquímetro digital) e digital (software) após escaneamento 3D para medições dentárias e dos arcos dentários, a fim de padronizar a metodologia e facilitar o desenvolvimento de estudos clínicos futuros.

- Avaliar compasso de pontas secas e paquímetro digital para realização de medidas dentárias lineares em modelos de estudo físicos comparados à software digital para os mesmos modelos de estudo após escaneamento 3D, por meio de estudo de concordância e reprodutibilidade.

- Comparar compasso de pontas secas e paquímetro digital para mensuração clínica do espaço do dente perdido diretamente na cavidade bucal de bebês e crianças expostos à perda de dentes decíduos anteriores, por meio de estudo de concordância e reprodutibilidade.

2.4 OBJETIVOS ESPECÍFICOS – 3ª FASE

- Avaliar as características dos arcos dentários e o desenvolvimento da oclusão de bebês e crianças de 0 a 6 anos de idade que perderam ou extraíram incisivos e caninos decíduos precocemente comparados à bebês e crianças sem perdas ou extrações dentárias precoces, por meio de um estudo observacional do tipo coorte.

3 DESENVOLVIMENTO DA PESQUISA

A fim de responder os objetivos do presente estudo, este foi dividido em três fases, sendo elas:

- ✓ 1ª fase: Levantamento bibliográfico de toda a evidência científica disponível na literatura sobre a perda precoce de dentes decíduos anteriores e realização de uma revisão sistemática com meta-análise e de uma revisão crítica da literatura, bem como para o desenvolvimento de material didático-educativo (e-book) para auxílio dos alunos de Odontologia, cirurgiões-dentistas recém-formados e clínicos sobre a perda precoce de dentes decíduos anteriores.

- ✓ 2ª fase: Comparação dos instrumentos compasso de pontas secas, paquímetro digital e software digital para medidas dentárias lineares em modelos de estudo físicos e digitais (Es1) e, comparação do compasso de pontas secas e paquímetro digital para mensuração do espaço do dente perdido diretamente na cavidade bucal do bebê/criança (Es2), respectivamente, por meio de dois estudos de concordância e reprodutibilidade.

- ✓ 3ª fase: Avaliação das alterações nas arcadas dentárias e no desenvolvimento da oclusão de bebês e crianças de 0 a 6 anos de idade que perderam ou extraíram incisivos e caninos decíduos precocemente comparados à bebês e crianças sem perdas ou extrações dentárias precoces, por meio de um estudo observacional do tipo coorte.

Dado que, os poucos estudos presentes na literatura que avaliam as consequências da perda ou extração precoce de dentes decíduos anteriores exibem falhas metodológicas relevantes, não apresentam padronização dos instrumentos de pesquisa e não permitem fácil reprodução da metodologia, a 2ª fase teve como objetivo avaliar diferentes instrumentos para mensurações dentárias e dos arcos dentários a fim de padronizar a metodologia e facilitar o desenvolvimento de estudos clínicos futuros.

As três fases desse trabalho foram realizadas no Departamento de Odontopediatria e Ortodontia da Faculdade de Odontologia da Universidade Federal do Rio de Janeiro (FO/UFRJ). As etapas clínicas foram realizadas na Clínica de Bebês e no Centro de Vigilância e Monitoramento de Traumatismos Dentolveolares da Faculdade de Odontologia da UFRJ (CVMT®/FO-UFRJ).

O estudo somente teve início após a aprovação no Comitê de Ética em Pesquisa do Hospital Universitário Clementino Fraga Filho – Universidade Federal do Rio de Janeiro (HUCFF/UFRJ) (CAAE 02502818.7.0000.5257, versão 1, número do parecer: 3.093.819) (Anexo A) com as emendas aceitas: versão 2, número do parecer: 4.609.804 (Anexo B) e versão 3, número do parecer: 5.621.927 (Anexo C). As assinaturas dos responsáveis referentes ao Termo de Consentimento Livre e Esclarecido (TCLE) (Apêndice A) foram obtidas.

3.1 1ª FASE DO ESTUDO

Devido à ausência de evidências científicas robustas na literatura sobre as consequências e possíveis intervenções para perda precoce de dentes decíduos anteriores, a 1ª Fase do estudo teve como objetivo realizar um levantamento bibliográfico das informações disponíveis na literatura sobre o tema. Foram desenvolvidas: revisão sistemática e meta-análise, revisão crítica da literatura e desenvolvimento de e-book.

3.1.1 Revisão Sistemática e Meta-análise

Buscando-se responder à pergunta foco: “Quais as consequências da perda precoce de dentes decíduos anteriores no padrão da fala e no arco dentário?”, uma revisão sistemática e meta-análise foi desenvolvida avaliando os efeitos da perda precoce de incisivos e caninos decíduos na fala e nos arcos dentários de bebês e crianças.

Inicialmente registrou-se a revisão no PROSPERO (CRD42019124392). Na sequência, uma busca sistemática, guiada por bibliotecária experiente em buscas, foi conduzida em cinco bases eletrônicas de dados, sendo elas: PubMed, Scopus, Web of Science, Cochrane Library, Lilacs/BBO (via VHL). Além disso, a literatura

cinza (OpenGrey) foi investigada. Foi realizada também uma busca manual nas listas de referência dos artigos selecionados.

A estratégia de busca usou termos MeSH e sinônimos relacionados à dentes decíduos anteriores, perda dentária e consequências à fala e ao perímetro do arco e selecionou aqueles estudos observacionais do tipo coorte que, preencheram os seguintes critérios de inclusão: população (P) – bebês e crianças, exposição (E) – perda ou extração precoce de incisivos e/ou caninos decíduos, controle (C) – comparação com bebês e crianças sem perdas, e desfecho (O) – consequências à fala e ao perímetro do arco dentário.

Os artigos foram inicialmente selecionados a partir da leitura dos seus títulos e resumos. Todo o processo de seleção foi realizado por dois avaliadores de forma independente e, em caso de dúvidas, entraram em consenso com um pesquisador mais experiente em revisões sistemáticas. Os artigos potencialmente elegíveis e aqueles com falta de informação no título e resumo foram lidos na íntegra a fim de estabelecer sua elegibilidade. Foram excluídos estudos que: correlacionaram a perda precoce com maloclusão ou com alterações na erupção dos dentes sucessores permanentes; que avaliaram a pronúncia de palavras antes e depois da utilização de mantenedores de espaço estéticos; que incluíram exodontia dos dentes decíduos anteriores por apinhamento e falta de espaço para os incisivos permanentes; quando os autores não especificaram o tipo de dente perdido; que avaliaram perdas dentárias fisiológicas; ausência de grupo de comparação; carta ao editor; e casos clínicos. Os artigos em duplicata foram computados apenas uma vez.

Após a seleção dos artigos, foi realizada uma coleta das informações, por meio de uma extração de dados dos artigos incluídos. Os dados extraídos foram (1) características do estudo como autor, ano de publicação e local de realização; (2) desenho do estudo; (3) características dos participantes como faixa etária, idade no momento da perda dentária, tamanho amostral e distribuição dos grupos (número de participantes expostos e não-expostos por grupo); (4) exposição, incluindo tipo de dente perdido, número de dentes perdidos, e a razão da perda precoce; (5) duração do estudo, momentos das avaliações e critério de avaliação utilizado; (6) desfecho, incluindo problemas na fala e/ou perda de espaço nos arcos dentários; (7) conclusão.

A avaliação da qualidade dos estudos foi realizada utilizando a Ferramenta da Cochrane ROBINS-I (STERNE et al., 2016) para acessar o risco de viés de estudos observacionais e não-randomizados. Os critérios de avaliação incluíram domínios de viés pré-observação: devido à fatores de confusão e na seleção dos participantes do estudo; viés durante a observação: na classificação das observações; e viés pós-observação: devido à desvios nas observações pretendidas, devido à falta de dados, na avaliação dos desfechos, e na seleção do resultado reportado.

Por último, foi realizada a síntese dos resultados. Como um dos estudos que avaliaram alterações no perímetro do arco não apresentou resultados numéricos, não foi possível realizar uma meta-análise para a perda de espaço. Os dados foram analisados usando o programa RevMan (Review Manager v. 5.3, The Cochrane Collaboration, Copenhaguen, Dinamarca) para avaliar a associação entre a perda precoce de dentes decíduos anteriores e problemas na fala. Foram realizadas meta-análises separadas de acordo com o problema de fala (distorção, omissão e substituição de palavras, sílabas ou letras). O número de problemas de fala (eventos) em crianças com (expostas) e sem (não-expostas) perdas dentárias precoces, e o número total foi incluído para calcular o risco relativo (RR) com 95% de intervalo de confiança (IC). A heterogeneidade do tamanho de efeito foi avaliada através do teste I^2.

3.1.2 Revisão Crítica da Literatura

Com o objetivo de apresentar e discutir as evidências disponíveis na literatura relativas à etiologia, diagnóstico, consequências e intervenções da perda precoce de dentes decíduos anteriores, uma busca bibliográfica foi realizada na base de dados do PubMed, utilizando termos MeSH, sinônimos e palavras-chave relacionadas com dentes decíduos anteriores e perdas dentárias, a fim de evitar qualquer restrição e maximizar o campo de busca. Foi também realizada uma busca manual nas listas de referência dos artigos selecionados.

Não houve restrição de desenho de estudo. Foram incluídos estudos observacionais, séries de casos, revisões de literatura, revisões sistemáticas, entre outros. Os artigos foram selecionados com base na avaliação dos títulos e resumos, em seguida, todos foram lidos na íntegra e os dados foram extraídos.

Foram extraídos dos estudos dados sobre: etiologia da perda dentária precoce; características clínicas da perda de incisivos e caninos decíduos; consequências morfológicas, tais como efeitos no desenvolvimento e erupção dos dentes sucessores permanentes e problemas relacionados à integridade dos arcos dentários; consequências funcionais como alteração na fonação e surgimento de hábitos não-nutritivos; consequências psicossociais afetando estética e qualidade de vida; e o manejo e possíveis intervenções para a perda precoce de dentes decíduos anteriores.

Quando os dados eram insuficientes ou inconclusivos, a análise crítica baseou-se na opinião de especialistas na área e/ou consenso de investigadores experientes. A revisão compreendeu uma ampla análise dos dados obtidos na literatura para encorajar discussões sobre as metodologias e desfechos dos artigos, bem como reflexões sobre estudos futuros. O objetivo final era a elaboração de um material que pudesse auxiliar profissionais de Odontologia na decisão da conduta clínica para casos de perda precoce de dentes decíduos anteriores considerando a melhor evidência científica disponível.

3.1.3 Livro Digital (E-book)

A inserção de tecnologias no processo educacional ganhou maior destaque durante a pandemia da COVID-19 em virtude da suspensão das aulas presenciais pela necessidade de distanciamento social (BARROS; VIEIRA, 2021). Sendo assim, as instituições de ensino precisaram aderir ao ensino à distância e adotar soluções tecnológicas, forçando professores e alunos a se adaptarem ao ambiente digital (UNITED NATIONS, 2020; MINISTÉRIO DA EDUCAÇÃO, 2021).

Assim como nas diversas áreas da educação, essa adaptação também ocorreu nos cursos de Odontologia. Mudanças como essas representam obstáculos desafiadores para as faculdades de Odontologia, visto que, a carga-horária do curso é especialmente prática, principalmente nos últimos períodos (FRANCO; CAMARGO; PERES, 2020; PENG et al., 2020). Educadores na área de Odontologia não só adaptaram a aula presencial ao ensino on-line, mas também, precisaram disponibilizar materiais didáticos digitais para auxílio dos alunos no processo de aprendizagem.

Dentre os materiais didáticos digitais, destaca-se o e-book, resultado do processo de digitalização das informações impressas (BENÍCIO; SILVA, 2005). Dentre as vantagens do uso de e-books podem-se destacar a disseminação de práticas baseadas em evidências, educação e conhecimento; a praticidade para leitura em qualquer lugar, inclusive pela tela do celular; a facilidade na portabilidade; a comunicação rápida, direta e dinâmica (MORETTI et al., 2018).

A utilização de e-books no processo de educação de alunos de Odontologia poderia ser visto como uma forma de educação complementar às aulas presenciais. Além de fornecer o conteúdo teórico sobre os mais diversos temas odontológicos, os e-books também apresentam imagens clínicas que auxiliam os alunos a estabelecer diagnósticos diferenciais e permitem a familiarização com a variedade de condições bucais.

Visto que, a perda precoce de dentes decíduos anteriores é um assunto pouco abordado na literatura científica e bastante recorrente no cotidiano das clínicas odontológicas, objetivou-se desenvolver um e-book para orientar alunos de Odontologia e cirurgiões-dentistas recém-formados e clínicos quanto ao diagnóstico, decisão terapêutica e tratamento, propriamente dito, da perda precoce de dentes decíduos anteriores.

O e-book foi criado na plataforma de design gráfico Canva (Sydney, Austrália) com base na melhor evidência científica disponível por meio dos dados de revisões de literatura, revisões sistemáticas, meta-análises e estudos clínicos. Foram utilizadas imagens e ilustrações da própria plataforma de design, do Google Imagens e do banco de imagens do CVMT®. O e-book abordou com linguagem dinâmica, simples e didática os seguintes tópicos: importância da dentição decídua, definição e classificação da perda precoce de dentes decíduos, etiologia da perda dentária anterior, características e consequências específicas da perda de incisivos e de caninos decíduos, discussão sobre tratar ou não tratar a perda precoce anterior e, as possibilidades de tratamento, propriamente ditas.

3.2 2ª FASE DO ESTUDO

O reconhecimento da validade de um estudo é um passo importante no processo de avaliação de uma pesquisa científica e alguns cuidados devem ser

tomados. A metodologia de um estudo deve ser relatada com detalhes, de fácil reprodução e apropriada em relação aos objetivos (CRATO et al., 2004). Nessa perspectiva, observa-se que os estudos que, avaliam as consequências da perda precoce anterior na integridade dos arcos dentários presentes na literatura, não apresentam: fácil reprodução das etapas metodológicas empregadas; definições para classificação das variáveis estudadas; e instrumentos de pesquisa previamente testados e validados. Dessa forma, a 2ª Fase do estudo objetivou selecionar instrumentos de medição dentária e de arco dentário a fim de padronizar a metodologia de futuros estudos clínicos, por meio de dois estudos de concordância e reprodutibilidade.

3.2.1 Estudo de concordância e reprodutibilidade para medições em modelos de estudo

Arcos dentários decíduos de bebês e crianças foram medidos com o objetivo de avaliar a concordância e a reprodutibilidade de medidas dentárias lineares realizadas nos modelos digitais por meio de software em comparação com medições realizadas diretamente sobre os modelos de gesso com compasso de pontas secas e paquímetro digital.

3.2.1.1 Participantes

A amostra de conveniência foi composta por bebês e crianças com dentição decídua, de 0 a 6 anos de idade, incluindo ambos os sexos, que apresentavam perda ou extração precoce de incisivo(s) e/ou canino(s) decíduo(s) em decorrência de traumatismo dentoalveolar e aqueles sem perdas ou extrações dentárias precoces que procuraram atendimento no CVMT® e na Clínica de Bebês do Departamento de Odontopediatria e Ortodontia da FO/UFRJ.

Foram excluídos bebês e crianças com necessidades especiais; perda ou extração precoce de dentes decíduos posteriores; dentes com lesões de cárie cavitadas e/ou restauração; presença de hábitos não-nutritivos; presença dispositivos ortodônticos ou ortopédicos; comportamento definitivamente negativo (FRANKL et al., 1962), a moldagem das arcadas impossível; não preenchimento do TCLE pelos responsáveis; ou não preenchimento de algum dos critérios de inclusão.

3.2.1.2 Coleta de dados

Inicialmente, foram obtidos modelos de gesso a partir das impressões dos arcos dentários dos participantes. Estes modelos foram escaneados individualmente e de forma cega utilizando o scanner ótico 3D (Open Technologies, Rezzato, Lombardia, Itália). A sequência de digitalização dos modelos consistiu primeiramente na digitalização do modelo superior, seguida do modelo inferior e, por último, digitalização dos modelos ocluídos, a fim de obter a relação entre as arcadas.

Foram consideradas seis medidas dentárias lineares relativas ao desenvolvimento dos arcos dentários (PADMA KUMARI; RETNAKUMARI, 2006): (1) espaço do dente perdido (se houvesse), (2) perímetro do arco, (3) largura do arco, (4) comprimento do arco, (5) largura intercaninos e (6) comprimento intercaninos.

Dois operadores treinados e calibrados realizaram as medições, diretamente e digitalmente nos modelos de estudo, de forma cega e independente. As medições foram realizadas com compasso de pontas secas (ICE, Cajamar, São Paulo, Brasil) e paquímetro digital (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japão) diretamente nos modelos de gesso e, digitalmente nos modelos escaneados utilizando o programa Autodesk Meshmixer (versão 3.5.474, Califórnia, Estados Unidos da América) (YOUSEFI et al., 2021).

As amostras foram mensuradas com os diferentes instrumentos de maneira aleatória, a fim de evitar que as medidas de um instrumento influenciassem as medidas dos outros. Todos os dados foram tabulados em tabelas individuais para cada operador.

3.2.1.3 Análise estatística

A análise estatística foi realizada utilizando o programa Jamovi, versão 2.2 (Sydney, Austrália). O CCI foi aplicado para calcular a reprodutibilidade inter-examinador, avaliando a reprodutibilidade das medidas entre os examinadores em cada tipo de modelo. O teste de Bland-Altman foi utilizado para avaliar a concordância das mensurações realizadas em modelos de gesso comparadas às mensurações dos modelos digitais entre os dois examinadores. A média da diferença entre os instrumentos e os limites de concordância foram utilizados para explicar as comparações dos dados.

3.2.2 Estudo de concordância e reprodutibilidade para mensurações clínicas do espaço do dente perdido

O espaço do dente perdido foi medido diretamente na cavidade bucal de bebês e crianças que perderam precocemente dente(s) decíduo(s) anterior(es), tanto com compasso de pontas secas quanto com paquímetro digital com o objetivo de avaliar a concordância e a reprodutibilidade entre os instrumentos. A medição não ocorria no mesmo dia da perda dentária.

3.2.2.1 Participantes

A amostra consistiu em bebês e crianças, de 1 a 5 anos de idade, incluindo ambos os sexos que haviam perdido prematuramente incisivo(s) e/ou canino(s) decíduo(s) devido ao traumatismo dento-alveolar. Os critérios de inclusão foram: bebês e crianças com perda ou extração precoce de um ou mais incisivos e/ou caninos decíduos, boa saúde geral, dentição decídua ou mista, e ausência de aparelhos ortodônticos ou ortopédicos. O único critério de exclusão foi quando o bebê/criança apresentou um comportamento definitivamente negativo (FRANKL et al., 1962), tornando a mensuração clínica do espaço impossível.

3.2.2.2 Coleta de dados

Dois operadores treinados realizaram, de forma independente, a mensuração do espaço do dente perdido diretamente na cavidade bucal com compasso de pontas secas (ICE, Cajamar, São Paulo, Brasil) e com paquímetro digital (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japão).

A fim de atingir o cegamento, um dos operadores realizava a primeira medição com o compasso de pontas secas sem confirmar o valor obtido na régua de plástico (Acrimet®, São Bernardo do Campo, São Paulo, Brasil), e em seguida, realizava a segunda medição com paquímetro digital. Depois disso, o outro operador executava os mesmos procedimentos, sem o conhecimento dos valores obtidos pelas mensurações do primeiro operador. Um terceiro operador confirmava os números obtidos pelo compasso sempre na mesma régua de plástico e anotava os dados obtidos pelos dois operadores.

O espaço da perda dentária foi definido como a distância linear entre os pontos mais proeminentes das superfícies interproximais dos dentes adjacentes ao espaço edêntulo.

3.2.2.3 Análise estatística

A análise estatística foi realizada utilizando estatísticas descritivas e inferenciais. Os dados descritivos incluíram média de idade, sexo e tipo de dentes perdidos. A análise inferencial foi realizada no software SPSS® (versão 21.0, SPSS Inc., Chicago, IL, Estados Unidos da América).

O teste-T foi utilizado para avaliar se as diferenças entre os instrumentos eram estatisticamente significativas. A concordância entre os instrumentos era confirmada quando valores de $p>0,05$. O teste Bland-Altman foi empregado para identificar a média da diferença e para construir limites de concordância a fim de gerar gráficos e demonstrar a concordância entre os instrumentos de medida. O intervalo de confiança de 95% foi considerado. O viés de proporção foi calculado pela análise de regressão linear simples para indicar a homogeneidade da distribuição das diferenças em torno do valor médio. Este enviesamento foi identificado em $p<0,05$.

O CCI foi também aplicado para calcular a reprodutibilidade inter-examinadores, avaliando a reprodutibilidade das medições entre os examinadores. A classificação do grau de consistência utilizada foi a proposta por Koo E Li (2016) para interpretar o valor CCI: < 0,5 = pobre; 0,5 - 0,75 = moderado; 0,75 -0,9 = bom; > 0,9 = excelente.

3.3 3ª FASE DO ESTUDO – ESTUDO OBSERVACIONAL DO TIPO COORTE

3.3.1 Desenho do estudo

O presente estudo é um estudo observacional longitudinal do tipo coorte prospectivo que teve como objetivo avaliar as arcadas dentárias e o desenvolvimento da oclusão de bebês e crianças dos 0 aos 6 anos de idade que tiveram perda ou extração precoce de incisivo(s) e/ou canino(s) decíduo(s) em comparação com bebês e crianças sem perda ou extração dentária precoce.

3.3.2 Contexto

O estudo foi aprovado no Comitê de Ética em Pesquisa do Hospital Universitário Clementino Fraga Filho – Universidade Federal do Rio de Janeiro (HUCFF/UFRJ) (02502818.7.0000.5257, versão 1, número do relatório: 3.093.819) e o TCLE (Apêndice A) foi fornecido para todos os responsáveis autorizando a participação dos bebês/crianças no estudo.

Os participantes elegíveis que procuraram atendimento no CVMT® e na Clínica de Bebês do Departamento de Odontopediatria e Ortodontia da FO/UFRJ compuseram a amostra. O período de recrutamento dos participantes ocorreu entre Abril de 2019 e Março de 2020. O estudo pretendia avaliar clinicamente bebês e crianças inicialmente e revê-los nas consultas de acompanhamento 6 e 12 meses após. Contudo, devido à pandemia da COVID-19, a maioria dos participantes só foi avaliada no tempo zero e no mínimo após 24 meses, com a finalização da coleta dos dados em Março de 2022.

3.3.3 Participantes

Os critérios de inclusão para o grupo exposto eram bebês e crianças com idade entre 0 e 6 anos com perda ou extração precoce de um ou mais incisivos e/ou caninos decíduos superiores ou inferiores em decorrência de traumatismo dento-alveolar, cárie ou dente neonatal; dentição decídua incompleta, decídua completa ou dentição mista; boa saúde geral – ausência de alteração de desenvolvimento, sistêmica ou neurológica –; ausência de lesões cariosas cavitadas, de restaurações e de dispositivos ortodônticos ou ortopédicos. Os mesmos critérios de inclusão foram utilizados para o grupo não-exposto, exceto pelo fato de que, os participantes desse grupo não deveriam apresentar perdas ou extrações dentárias.

Os critérios de exclusão estabelecidos para ambos os grupos eram bebês e crianças com necessidades especiais; perda ou extração de dentes decíduos posteriores; presença de hábito não-nutritivo; tratamento ortodôntico ou ortopédico presente ou prévio; comportamento definitivamente negativo (FRANKL et al., 1962), tornando a mensuração clínica do espaço e/ou a moldagem das arcadas impossível; não preenchimento do TCLE pelos responsáveis; ou não preenchimento de algum dos critérios de inclusão.

3.3.4 Tamanho amostral

O tamanho da amostra foi calculado pelo G*Power (versão 3.1.9.3; Düsseldorf, Alemanha) baseado na média e desvio padrão de estudo prévio publicado na literatura (LIN; LIN; LIN, 2007) que avaliou alterações de espaço seis meses após a perda precoce de primeiros molares decíduos. Considerando um poder de estudo de 80% e α=0,05%, 34 bebês e crianças eram necessários para compor a amostra do presente estudo.

No entanto, uma amostra de conveniência foi adotada após a coleta de dados em decorrência do surgimento da pandemia da COVID-19 que, desencadeou a suspensão das atividades clínicas da FO/UFRJ de Março de 2020 a Novembro de 2021. Logo, como não seria possível recrutar o número inicialmente previsto de participantes, optou-se pela amostra de conveniência e aumento do tempo de acompanhamento de doze para, no mínimo, vinte e quatro meses.

3.3.5 Coleta de dados

3.3.5.1 Treinamento e calibração

O examinador principal foi treinado e calibrado por um professor do Departamento de Odontopediatria e Ortodontia da FO/UFRJ (padrão-ouro) para todas as variáveis que foram mensuradas durante o estudo: exame de oclusão, medição do espaço do dente perdido clinicamente, medições nos modelos de estudo físicos e digitais das medidas dentárias lineares: perímetro do arco, largura do arco, comprimento do arco, largura intercaninos e comprimento intercaninos. Para os casos de perda precoce de canino decíduo, as medições de largura e comprimento intercaninos não eram realizadas.

3.3.5.2 Dados gerais dos participantes

Os responsáveis foram convidados e autorizaram a participação dos bebês e crianças no estudo pela assinatura do TCLE (Apêndice A). Foram realizadas entrevistas com os pais/responsáveis para coleta dos seguintes dados: idade, sexo

e história médica e odontológica, previamente ao atendimento odontológico. Essas informações foram registradas na ficha clínica do bebê/criança.

3.3.5.3 Exame clínico

O exame clínico foi realizado pelo examinador com o bebê/criança sentado(a) na cadeira odontológica sob ótima iluminação, auxílio de espelho bucal, sonda exploradora de ponta romba e jatos de ar.

Em seguida, o exame da oclusão foi realizado, sendo avaliado: tipo de dentição – decídua completa, decídua incompleta ou mista; presença de maloclusão; tipo de arco decíduo de Baume – tipo I ou II (BAUME, 1950); relação de caninos decíduos – Classe I, II ou III. Para os casos de perda precoce de caninos decíduos ou quando o bebê não apresentava algum dos caninos decíduos totalmente erupcionado, a relação de caninos não era classificada.

3.3.5.4 Documentação intrabucal

3.3.5.4.1 Fotografias intrabucais

Foram realizadas fotografias intrabucais do participante em oclusão. Quando esta não foi possível por falta de colaboração, fotografias intrabucais das arcadas dentárias fora de oclusão foram tiradas. Para a padronização das imagens, todas as fotografias foram tiradas com a câmera digital Canon Eos Rebel T3i (Tóquio, Japão), lente macro (Tokina 100/2,8 AT-X PRO D – Canon, Tóquio, Japão), flash circular (Macro Circular Meike Mk-14ext – Canon, Tóquio, Japão) e auxílio de afastadores labiais infantis.

3.3.5.4.2 Exame radiográfico

Segundo as recomendações da Academia Americana de Odontopediatria (AAPD, 2017/2018), o julgamento quanto à necessidade e tipo das imagens radiográficas para avaliação de relações dentárias ou esqueléticas em bebês e crianças com dentição decídua, é clínico. Diante disso, optou-se pela não realização

de aquisições radiográficas pois os participantes já estavam em acompanhamento ou tratamento na Clínica de Bebês e no CVMT®/FO-UFRJ.

3.3.5.4.3 Moldagem e modelo de estudo

Foram realizadas moldagens das arcadas superior e inferior de todos os bebês e crianças com alginato Orthoprint Tipo I (Zhermack, Badia Polesine, Itália) em moldeiras de plástico vazadas (Maquira, Maringá, Paraná, Brasil; Morelli, Sorocaba, São Paulo, Brasil) ou moldeiras de alumínio (Tecnodent, Indaiatuba, São Paulo, Brasil), dependendo do tamanho da arcada dentária. Quando a moldagem não apresentava qualidade diagnóstica suficiente pelo comportamento negativo do bebê/criança, ela era repetida até que a qualidade ficasse aceitável.

Os modelos de estudo foram construídos com gesso especial ortodôntico (Asfer Indústria Química Ltda, São Caetano do Sul, São Paulo, Brasil) na proporção recomendada pelo fabricante. Após a presa do material, os modelos foram recortados de acordo com a literatura (CAMARGO; MUCHA, 1999) por uma técnica experiente em prótese.

3.3.6 Mensuração dos dados

3.3.6.1 Mensuração clínica

O espaço do dente perdido ou extraído foi mensurado entre os pontos mais proeminentes das superfícies interproximais dos dentes adjacentes ao espaço edêntulo com o auxílio de um paquímetro digital (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japão).

3.3.6.2 Mensuração dos modelos de estudo

Para avaliação dos modelos de estudo, foram realizadas seis medidas dentárias lineares de referência (PADMA KUMARI; RETNAKUMARI, 2006):

- Espaço do dente perdido/extraído: distância entre a face interproximal dos dentes adjacentes ao dente perdido.

- Perímetro do arco: mensuração do arco a partir do ponto médio na distal do segundo molar decíduo (ou do último dente que estiver presente no arco) de um lado até o outro lado, passando pelas pontas das cúspides dos caninos e margens incisais dos incisivos.

- Largura do arco: distância entre as fossas centrais das superfícies oclusais dos segundos molares decíduos (ou primeiros molares decíduos, caso aqueles ainda não estejam presentes).

- Comprimento do arco: distância perpendicular do ponto de contato dos incisivos centrais até a linha que passa entre as fossas centrais das superfícies oclusais dos segundos molares decíduos (ou primeiros molares decíduos, caso aqueles ainda não estejam presentes).

- Largura intercaninos: distância entre as pontas das cúspides dos caninos decíduos.

- Comprimento intercaninos: distância perpendicular do ponto de contato dos incisivos centrais até a linha que passa pelas pontas das cúspides dos caninos decíduos.

Tanto os modelos iniciais como os modelos das consultas de acompanhamento foram digitalizados (PARK; JUNG; KIM, 2009) com scanner ótico 3D (Open Technologies, Rezzato, Lombardia, Itália). Um operador treinado e calibrado realizou digitalmente as medidas dentárias lineares de forma cega utilizando o programa Autodesk Meshmixer (versão 3.5.474, Califórnia, EUA) (YOUSEFI et al., 2021).

3.3.6.3 Avaliação do erro do método

Todas as medidas digitais foram repetidas após um intervalo de 1 mês para avaliação do erro do método. A reprodutibilidade intra-examinador foi avaliada pelo cálculo do CCI. A precisão do método e erro sistemático foram avaliados pelo método de Bland-Altman através da estimativa do viés de proporção.

3.3.7 Análise estatística

A análise estatística foi realizada utilizando o programa Jamovi, versão 2.2 (Sydney, Austrália), adotando um nível de significância de 0,05%. Estatística descritiva foi utilizada para apresentação dos dados (frequência relativa absoluta e média e desvio padrão para as medidas dos arcos dentários). O teste de Shapiro-Wilk foi utilizado para verificar a normalidade dos dados. Verificada a normalidade, o teste-t foi empregado para comparar as mudanças nas medidas dentárias lineares entre o grupo exposto e o grupo não-exposto. O teste de Levene's foi utilizado para avaliar a normalidade das variâncias.

4 DESENVOLVIMENTO DA PESQUISA

4.1 Artigo 1: Premature loss of primary anterior teeth and its consequences to primary dental arch and speech pattern: A systematic review and meta-analysis.

Artigo publicado: Nadelman P, Bedran N, Magno MB, Masterson D, de Castro ACR, Maia LC. Premature loss of primary anterior teeth and its consequences to primary dental arch and speech pattern: A systematic review and meta-analysis. **Int J Paediatr Dent**. 2020 Nov;30(6):687-712. doi: 10.1111/ipd.12644. Epub 2020 Apr 20. PMID: 32243000.

4.2 Artigo 2: Does the premature loss of primary anterior teeth cause morphological, functional and psychosocial consequences?

Artigo publicado: Nadelman P, Magno MB, Pithon MM, Castro ACR, Maia LC. Does the premature loss of primary anterior teeth cause morphological, functional and psychosocial consequences? **Braz Oral Res**. 2021 Nov 19;35:e092. doi: 10.1590/1807-3107bor-2021.vol35.0092. PMID: 34816892.

4.3 Produto técnico – e-book: Perda precoce de dentes decíduos anteriores.

Produto técnico publicado: Nadelman P, Jural L, Fonseca-Gonçalves A, Pithon MM, Castro ACR, Maia LC. **http://hdl.handle.net/11422/15692**

4.4 Artigo 3: Comparison of three instruments (analog, analog with digital display, and digital) for dental linear measurements on plaster and digitalized models of infants and children: an agreement and reproducibility study.

Nadelman P, Vargas EOA, Pithon MM, Castro ACR, Maia LC.

Artigo a ser submetido para a revista American Journal of Orthodontics and Dentofacial Orthopedics (AJODO).

4.5 Artigo 4: How to measure the space of premature loss of primary anterior teeth? An agreement and reproducibility study comparing compass and digital caliper. Nadelman P, Amorim CS, Pithon MM, Castro ACR, Maia LC

Artigo a ser submetido para a revista International Journal of Paediatric Dentistry (IJPD).

4.6 Artigo 5: Occlusion development of exposed and unexposed children to the premature loss of primary anterior teeth: preliminary results of a 24-month follow-up cohort study. Nadelman P, Vargas EOA, Marañón-Vásquez GA, Vollu AL, Pithon MM, Castro ACR, Maia LC

Artigo a ser submetido para a revista IJPD.

4.1 Artigo 1: Premature loss of primary anterior teeth and its consequences to primary dental arch and speech pattern: A systematic review and meta-analysis.

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REVIEW

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Premature loss of primary anterior teeth and its consequences to primary dental arch and speech pattern: A systematic review and meta-analysis

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Abstract

Background: Information about the functional and morphological consequences that occur following the premature loss of anterior teeth is still insufficient.

Aim: To evaluate the consequences in children's speech and arch integrity following premature loss of primary anterior teeth compared to those without premature losses.

Design: Electronic searches were performed based on the PECO criteria. Observational studies in children (P) who suffered premature loss or extraction of primary anterior teeth (E) compared to children presenting normal occlusion development (C) and the consequences to speech and dental arch perimeter (O) were included. Risk of bias and data extraction were performed. The meta-analysis evaluated the influence of premature loss of primary anterior teeth in articulatory speech disorders (distortion, omission, and substitution) and space loss in the dental arches. Random- and fixed-effect models were used, and heterogeneity was tested. The certainty of evidence was estimated using the GRADE approach.

Results: From a total of 2.234 studies, six studies were included in the qualitative synthesis, and four in speech disorders meta-analysis. Despite it was not possible to perform space loss meta-analysis due to the absence of available data, qualitative analysis showed that there was no space loss after premature loss of mandibular primary incisors; a space loss, however, could be observed in children who lost primary canines at an early stage of dental development. For speech disorders results, children who lost anterior tooth presented higher chance of suffering speech distortion, than children without tooth loss (OR 5.466 [1.689, 17.692] $P = .005$) with low certainty of evidence. On the other hand, there were no statistically differences between premature loss of primary anterior teeth and omission (OR (a) 1.157 [0.439, 3.049] $P = .767$ and (OR (b) 1.393 [0.434, 4.70] $P = .577$) or substitution (OR (a) 1.071 [0.581, 1.974] $P = .827$ and OR (b) 1.218 [0.686, 2.163] $P = .5$), both with very low certainty of evidence.

Conclusions: Premature loss of primary anterior teeth may affect children phonation causing speech distortion. Consequences of space loss to primary dental arch

still need to be further studied. Despite the speech distortion results, included articles present low-level evidence-based quality, thus new studies should be performed.

KEYWORDS

cuspid, incisor, orthodontic space closure, speech disorders, tooth primary, tooth loss

1 | INTRODUCTION

Primary dentition has extreme functional and morphological importance for children growth. Functionally, primary anterior teeth contribute to mastication development, guide the incisive function and support the phonation progress. Morphologically, the maintenance of primary arch integrity exerts a strong influence on the maintenance of arches' length, influencing on permanent dentition development and guiding successor teeth eruption.[1-3]

Due to this great importance, the premature loss of primary teeth has been considered an oral health problem. The loss of a primary tooth is considered premature when it occurs at least 1 year before its normal exfoliation or while the successor permanent tooth is still before Nolla's stage six, as evidenced through radiographic examination, where the coronary formation is complete and the root is less than two-thirds completed.[4,5]

Sequelae resulted from premature loss of anterior teeth could affect patient's speech evolution[6-8] and cause problems related to arch integrity.[9,10] Regarding phonation, it is known that teeth play an important role during the production of certain speech sounds. Consequently, loss of anterior teeth may result in speech disorders, characterized by difficulty of articulating words. Basically, it consists of the impairment pronunciation of words, either by omitting or by adding phonemes, exchanging one phoneme for another or even distorting them neatly.[11]

Moreover, if the primary arch integrity is compromised, it can deflagrate problems of permanent tooth alignment due to arch perimeter reduction, antagonist teeth extrusion, adjacent teeth migration and inclination, successor teeth impaction and early or late eruptions, midline deviation, and a discrepancy between the space available in the arch and the space needed for accommodation of the successor teeth.[12]

Despite above-mentioned evidence, information about the functional and morphological consequences that occur following the premature loss of anterior teeth is still insufficient. Furthermore, there are only systematic reviews evaluating changes after the premature loss of posterior teeth.[13,14] In view of this, the purpose of this systematic review and meta-analysis was to evaluate the consequences in children's speech and arch integrity following premature loss of primary anterior teeth compared to those without premature losses.

Why this paper is important to paediatric dentists

- To support paediatric dentists through a scientific evidence in the treatment decision in cases of premature loss of primary anterior teeth
- To inform paediatric dentists that the literature on the subject is outdated, scarce and has generally important methodological limitations with low-level evidence-based quality
- To update paediatric dentists that premature loss of primary anterior incisors may cause speech distortion; therefore, professionals need to plan the patient's treatment with space maintenance and request a speech therapy follow-up.

2 | MATERIALS AND METHODS

2.1 | Protocol and registration

The study protocol was registered on the PROSPERO database (http://www.crd.york.ac.uk/PROSPERO) under the number CRD42019124392. The PRISMA statement recommendations for the report of systematic review were followed.[15]

2.2 | Eligibility criteria

The Population, Exposition, Comparisons, and Outcome (PECO) strategy[16] was determined. The review focused question was: 'What are the consequences of premature loss of primary anterior teeth in the speech pattern and in the dental arch?'.

Observational studies that evaluated children (P) who suffered premature loss or extraction of primary anterior teeth (E) compared to children presenting normal occlusion development (C) and the consequences to speech and dental arch perimeter (O). Search included changes in the speech with pronouncing problems, such as speech distortion, substitution, and omission. Changes in arch integrity included loss of

space in the dental arch, and consequently, arch perimeter-related problems.

Additionally, as exclusion criteria, case reports, case series, descriptive studies, review articles, opinion articles, and editorial letters, studies using animals, in vitro and in situ studies were eliminated. After full-text reading, more observational studies were excluded if (a) the study correlated premature losses with malocclusion, with eruption of permanent successors, or with effect of space maintainers; (b) the extraction of primary teeth occurred due to crowding and lack of space for permanent incisors; (c) the study evaluated consequences of physiological tooth loss; (d) absence of a control group; and (e) the author did not specify the type of tooth lost.

2.3 | Literature search strategy

A systematic literature search was conducted on the following electronic databases: PubMed MEDLINE, Scopus, Web of Science, Cochrane Library, Lilacs/BBO (via VHL), and Open Grey up to March 2020. Search strategies defined for the databases described above are listed in Table 1. Two reviewers (PN and NBR) performed the search strategy to identify eligible studies. An expert librarian (DM) guided the search strategy. Experts in the fields were also contacted to help the systematic search.

The search strategy used MeSH terms and several synonyms related to primary anterior teeth, tooth loss and consequences to speech and arch perimeter, in order to avoid any restriction and maximize the search field in this research phase. Search terms were adapted for each database. No restrictions were placed on the publication data or language. Articles published up to March 2020 were considered for this review. Articles available in more than one database were considered only once. A manual search was performed on the reference lists of the selected articles. Alerts with the search strategy were created in the databases.

2.4 | Study selection

Two review authors (PN and NBR) performed study selection independently through evaluation of the titles and abstracts of all studies identified in the electronic databases. Full articles were retrieved and examined when their title and abstract did not provide enough information for a definite decision. An identification tag was given to each eligible study, combining first author and year of publication. If any article could not be achieved, the authors were contacted via e-mail, Research Gate or Facebook, and institutional contact. Other study's centres around the world were contacted too in order to retrieve the articles in their libraries.

Any disagreements regarding the eligibility of included studies were resolved through consensus, or with the help of a third author (LCM). Irrelevant records were excluded, and the reasons for their exclusion were noted (Figure 1—flow chart).

2.5 | Data collection process

Two review authors (PN and NBR) extracted the data using customized extraction forms and any disagreements or doubts between the reviewers were also solved through discussion, and if needed, by consulting a third reviewer (LCM). The following data were recorded for each included study:

Details of the (a) study, including author(s), year of publication and place where the study was undertaken; (b) study design; (c) participants, comprising age range, age at the moment of tooth loss, sample size, and distribution of groups (number of exposed and not-exposed participants per group); (d) exposition, including the affected teeth, the number of teeth extracted or lost, and the reason of the extraction or loss; (e) duration of the study, evaluation timepoints, and evaluation criteria used for assessment; (f) outcomes, including speech problems and/or space loss in the dental arches; and (g) conclusions.

2.6 | Risk of bias assessment

Quality assessment of the individual included studies was performed by three independent reviewers (PN, NBR, and MBM), using ROBINS-I tool[17] from Cochrane Methods for assessing risk of bias in non-randomized and observational studies. This quality assessment allowed the ranking of cohort, case-control and cross-sectional studies. The assessment criteria included domains about pre-observation bias: due to confounding and in selection of participants into the study; during the observation bias: in classification of observations; and post-observation bias: due to deviations from intended observations, due to missing data, in measurement of outcomes, and in selection of the reported result.

The categories for judgement of risk of bias were 'low risk', 'moderate risk', 'serious risk', and 'critical risk'. Additionally, the '*no information*' category was used when there were insufficient data for conclusion. According to the ROBINS-I, the domain is considered as having 'low risk of bias' if the study is comparable to a well-performed randomized trial to the domain; as having 'moderate risk of bias' if the study is sound for a non-randomized trial with regard to the domain but cannot be considered comparable to a well-performed randomized trial; as having 'serious risk of bias' when the study has some important problems; and as having 'critical risk of bias' when the study is too problematic

to provide any useful evidence on the effects of observation. The overall risk of bias of each study is defined as the most severe judgement given to one of the domains.

Regarding the 'confounding' domain, the studies should control at least three important confusing features: presence of malocclusion, deleterious habits, and previous history of speech problems. The 'selection of participants into the study' was considered to have low risk of bias if all participants who would have been eligible for the target trial were included in the study. With regard to the 'classification of observations', the risk of bias decreased when some aspects of the observation status assignments were determined retrospectively such as recruitment of patients through records. The 'deviations from intended observation' should be controlled by excluding patients that: received speech therapy and were treated with space maintainers, what could affect the study outcome. The risk of bias of 'missing data' started to decrease when the study presented any proportion of missing participants—missing more than 20% of the sample was considered a critical risk of bias. In respect to 'measurement of outcomes', the studies' methods of outcome assessment should be comparable across observation groups, have been performed by a professional in the area and present blindness and kappa value. Finally, the 'selection of the reported result' should evidence that all reported results corresponded to all intended outcomes and analyses.

2.7 | Meta-analysis

Since one of the two studies that evaluated changes in arch perimeter did not present numerical results, it was not possible to perform a meta-analysis for space loss. In this sense, qualitative syntheses were performed to evaluate the association between tooth loss and speech problems in children. Review Manager software was used.

Separated meta-analyses were performed according to the speech problem (distortion, omission, and substitution of words, syllables, or letters). It was considered distortion: speech distortion and interdental lisping; it was considered omission any type of omissions (not specified, fricatives or stops omissions); and it was considered substitution any type of substitution (not specified and liquids substitutions) and pronouncing 's' and 'z'.

In meta-analysis of omission and substitution, more than one specific problem was considered in some studies. These specific problems could not be simply added since that one child could be included in both specific problem groups. This way, to avoid sample overlapping, separated meta-analysis was performed considering different specific speech problem reported by the studies and was described in forest plot as a subgroup within study.

The number of speech problems (events) in children with (case) and without (control) anterior tooth loss, and the total

TABLE 1 Search strategy

PubMed	(Tooth, Primary[Mesh] OR Primary tooth[tiab] OR Primary teeth[tiab] OR Primary teeth[tiab] OR Primary dentition[tiab] OR Primary dentition[tiab] OR Primary incisor*[tiab] OR Primary cuspid*[tiab] OR Primary cuspid*[tiab] OR Primary canine*[tiab] OR Primary canine*[tiab] OR Maxillary anterior teeth[tiab] OR Mandibular anterior teeth[tiab]) AND (Tooth Loss[Mesh] OR Tooth loss[tiab] OR Early loss*[tiab] OR Premature loss*[tiab] OR Extraction*[tiab] OR Missing[tiab] OR Tooth Avulsion[Mesh] OR Tooth avulsion[tiab]) AND (Orthodontic Space Closure[Mesh] OR Orthodontic*[tiab] OR Space closure[tiab] OR Space loss*[tiab] OR Space change*[tiab] OR Malocclusion[Mesh] OR Malocclusion*[tiab] OR Dental Occlusion[Mesh] OR Occlusion[tiab] OR Phonation[Mesh] OR Phonation[tiab] OR Speech[Mesh] OR Speech[tiab])
Scopus	*(TITLE-ABS-KEY ("Primary tooth") OR TITLE-ABS-KEY ("Primary teeth") OR TITLE-ABS-KEY ("Primary teeth") OR TITLE-ABS-KEY ("Primary dentition") OR TITLE-ABS-KEY ("Primary dentition") OR TITLE-ABS-KEY (primary AND incisor*) OR TITLE-ABS-KEY (primary AND cuspid*) OR TITLE-ABS-KEY (primary AND cuspid*) OR TITLE-ABS-KEY (primary AND canine*) OR TITLE-ABS-KEY (primary AND canine*) OR TITLE-ABS-KEY ("Maxillary anterior teeth") OR TITLE-ABS-KEY ("Mandibular anterior teeth")) AND (TITLE-ABS-KEY (orthodontic*) OR TITLE-ABS-KEY ("Space closure") OR TITLE-ABS-KEY (space AND loss*) OR TITLE-ABS-KEY (space AND change*) OR TITLE-ABS-KEY (malocclusion*) OR TITLE-ABS-KEY (occlusion) OR TITLE-ABS-KEY (phonation) OR TITLE-ABS-KEY (speech)) AND (TITLE-ABS-KEY ("Tooth loss") OR TITLE-ABS-KEY (early AND loss*) OR TITLE-ABS-KEY (premature AND loss*) OR TITLE-ABS-KEY (extraction*) OR TITLE-ABS-KEY (missing) OR TITLE-ABS-KEY ("Tooth avulsion"))*
Web of Science	Tópico: ((“Primary tooth” OR “Primary teeth” OR “Primary teeth” OR “Primary dentition” OR “Primary dentition” OR Primary incisor* OR Primary cuspid* OR Primary cuspid* OR Primary canine* OR Primary canine* OR “Maxillary anterior teeth” OR “Mandibular anterior teeth”)) AND Tópico: ((“Tooth loss” OR Early loss* OR Premature loss* OR Extraction* OR Missing OR “Tooth avulsion”)) AND Tópico: ((Orthodontic* OR “Space closure” OR Space loss* OR Space change* OR Malocclusion* OR Occlusion OR Phonation OR Speech))

(Continues)

TABLE 1 (Continued)

Cochrane	#1MeSH descriptor: [Tooth, Primary] explode all trees #2"primary tooth" #3"primary teeth" #4"primary teeth" #5"primary dentition" #6"primary dentition" #7#1 OR #2 OR #3 OR #4 OR #5 OR #6 #8primary incisor* OR primary cuspid* OR primary cuspid* OR primary canine* OR primary canine* OR "maxillary anterior teeth" OR "mandibular anterior teeth" #9#7 OR #8 #10MeSH descriptor: [Tooth Loss] explode all trees #11"tooth loss" #12"early loss" OR "early losses" #13"premature loss" OR "premature losses" #14"tooth extraction" OR "teeth extraction" #15"missing tooth" OR "missing teeth" #16#10 OR #11 OR #12 OR #13 OR #14 OR #15 #17MeSH descriptor: [Tooth Avulsion] explode all trees #18"tooth avulsion" #19#17 OR #18 #20#16 OR #19 #21MeSH descriptor: [Orthodontic Space Closure] explode all trees #22orthodontic* #23"space closure" #24space loss* #25space change* #26#21 OR #22 OR #23 OR #24 OR #25 #27MeSH descriptor: [Malocclusion] explode all trees #28malocclusion* #29#27 OR #28 #30MeSH descriptor: [Dental Occlusion] explode all trees #31occlusion #32#30 OR #31 #33MeSH descriptor: [Phonation] explode all trees #34phonation #35#33 OR #34 #36MeSH descriptor: [Speech] explode all trees #37speech #38#36 OR #37 #39#26 OR #29 OR #32 OR #35 OR #38 #40#9 AND #20 AND #39
Lilacs - BBO	tw:((tw:(tw:((mh: "Orthodontic Space Closure" OR "Fechamento de Espaço Ortodôntico" OR orthodontics OR ortodontia OR "Space closure" OR "Fechamento de espaço" OR "Space loss" OR "Perda de espaço" OR "Space losses" OR "Perdas de espaço" OR "Space change" OR "Alteração do espaço" OR mh: malocclusion OR "má oclusão" OR malocclusion OR "má oclusão" OR mh: "Dental Occlusion" OR "oclusão dentária" OR occlusion OR oclusão OR mh: phonation OR fonação OR phonation OR fonação OR mh: speech OR fala OR speech OR fala)))) AND (tw:(tw:((mh: "Tooth, Primary" OR "Dente decíduo" OR "Primary tooth" OR "Dente decíduo" OR "Primary teeth" OR "Dentes decíduos" OR "Primary teeth" OR "Dentes primários" OR "Primary dentition" OR "Dentição decídua" OR "Primary dentition" OR "Dentição primária" OR "Primary incisor" OR "Incisivo primário" OR "Primary incisors" OR "Incisivos primários" OR "Primary cuspid" OR "Canino primário" OR "Primary cuspids" OR "Caninos primários" OR "Primary cuspid" OR "Canino decíduo" OR "Primary cuspids" OR "Caninos decíduos" OR "Primary canine" OR "Canino primário" OR "Primary canines" OR "Caninos primários" OR "Primary canine" OR "Canino decíduo" OR "Primary canines" OR "Caninos decíduos" OR "Maxillary anterior teeth" OR "Dentes maxilares anteriores" OR "Mandibular anterior teeth" OR "Dentes mandibulares anteriores")))) AND (tw:(tw:((mh: "Tooth loss" OR "Perda de dente" OR "Tooth loss" OR "Perda de dente" OR "Early loss" OR "Perda precoce" OR "Early losses" OR "Perdas precoces" OR "Premature loss" OR "Perda prematura" OR "Premature losses" OR "Perdas prematuras" OR "tooth extraction" OR "extração dentária" OR "teeth extractions" OR "extrações dentárias" OR "missing tooth" OR "dente perdido" OR "missing teeth" OR "dentes perdidos" OR mh: "Tooth Avulsion" OR "Avulsão dentária" OR "Tooth avulsion" OR "Avulsão dentária"))))) AND (instance:"regional") AND (db:("LILACS" OR "BBO") AND type:("article"))
OpenGrey	"Primary tooth" OR "Primary teeth" AND "Tooth loss" OR "Premature loss" AND "Space closure" OR "Space loss"

number were included to calculate the risk ratio (RR) with 95% of confidence interval (CI). Heterogeneity of effect size was assessed by the I^2 test.

2.8 | Assessing the certainty of evidence

The certainty in the estimates of effect was determined for the outcome using the GRADE approach. Observational studies evaluated trough Robins-I started as high evidence, and the certainty of the evidence decreased if serious or very serious issues, related to risk of bias, inconsistency, indirectness, imprecision, and publication bias, were present. In addition, the quality of the evidence could be upgraded if the magnitude of effect was large or very large, or if the effect of all plausible confounding factors would reduce the effect, or suggested a spurious effect. In this way, the quality of the evidence could vary from very low to high.[18]

3 | RESULTS

3.1 | Study selection

The study selection process is presented in Figure 1 through a flow diagram of the search results from the databases. A total of 2.933 records were identified from databases, and 2.234 remained after removal of duplicates. Subsequently title and abstract reading, the number was further reduced to 42. The full texts of these 42 studies were assessed for eligibility. Eighteen were excluded because their abstracts or authors' contacts were not found. One additional study was identified by searching these papers references and accessed for full-text reading. From these 25 studies, 19 were excluded, as they did not fulfil the eligibility criteria—justifications for exclusions are presented in Figure 1. Thus, 6 articles were included in qualitative synthesis and 4 articles were included in quantitative synthesis.

3.2 | Characteristics of included articles

Characteristics of the six included studies are listed in Table 2. Three studies presented case-control design,[6,7,19] two studies were cohort studies,[8,20] and one study has been declared as a two-part epidemiological study.[21]

The primary maxillary incisors were the most frequently teeth affected,[6-8,19] followed by primary mandibular central incisors—natal teeth[20]—and primary canines.[21] The majority of the studies recruited children without premature losses to compose the control group,[6-8,19,20] except for one study that compared the side of the premature loss with the opposite intact side in the same patients.[21]

The number of participants included in these studies ranged from 30[19] to 52 participants.[6] The age of participants ranged from newborns[20] to 10 years[6,8] and the age at the moment of the loss varied from newborns[20] to 5 years old.[8] The reported causes of premature extraction or loss were early childhood caries,[19] hypermobility or tongue trauma by the natal teeth.[20]

The studies evaluated the occurrence of speech changes[6-8,19] or space loss[20,21] after premature losses. The speech evaluation was performed through the following tests: Goldman-Fristoe test of articulation,[7,8] photo articulation test,[6] and Ankara articulation test.[19] Space evaluation was assessed through measurements in alginate impressions, bite registration, and radiographs[21]; or clinical measurement of extraction space only with a pair of dividers to detect any space loss.[20]

3.3 | Risk of bias within studies

The assessment of the risk of bias of selected studies is presented in Table 3. One paper was considered to have a moderate risk of bias,[21] three a serious risk of bias,[7,8,19] and two to have a critical risk of bias.[6,20] This result was attributed mainly to bias due to confounding, deviations from intended observation, measurement of outcome, and selection of reported result.

Regarding the 'confounding' domain, one study was considered to have 'low risk of bias'[20] since no confounding was expected at the study baseline as a result that the patients were newborns. Three studies were classified as having 'serious risk of bias'[7,8,19] as they did not control at least one known important feature. One study was characterized as having 'critical risk of bias'[6] because confounding inherently was not controllable. And one study did not provide information about this issue.[21]

The majority of the studies were characterized as 'low risk of bias' in the 'selection of participants into the study'[6-8,20,21] because all the participants who would have been eligible for the research were included. Except from Turgut et al,[19] which was considered to be 'moderate risk of bias' because authors did not mention the sampling method and source of sample.

With regard to the 'classification of observations', three studies were classified as 'moderate risk of bias' in this domain since patients with history of premature loss were collected from records,[6-8] and the other three studies have 'low risk of bias'[19-21] as observation definition was based solely on information collected during the study period.

Most of the studies did not present any information about 'deviations from intended observation'.[7,8,19,20] One study was considered to have 'moderate risk of bias'[21] because the precise time of premature loss was unknown and authors did not discard the possibility that some of the children have had lost one or more additional primary teeth.

And another study was considered to have 'critical risk of bias'[6] because some patients have received speech therapy and patients with malocclusion were also included in the research.

Regarding 'missing data' information, only one study[21] was considered to have 'moderate risk of bias' in this domain because it presented a slight loss—lower than 20%.

The majority of the studies was considered to be 'low risk of bias' or 'moderate risk of bias' in 'measurement of outcomes', except from one study[20] that was characterized as having 'serious risk of bias' because the methods of outcome assessment were not comparable across the groups and the authors did not report how the measurement of space loss was performed.

Most of the studies were considered to be 'low risk of bias' or 'moderate risk of bias' in 'selection of the reported result', except from To, 1991,[20] which did not report any result from space loss; thus, it was considered as 'critical risk of bias'.

3.4 | Meta-analyses and certainty of evidence

Lamberguini et al[8] presented their results as continuous data, did not respond authors contact attempts and, for these reasons, was excluded from meta-analysis.

3.4.1 | 1st meta-analysis: Distortion speech problems

Three studies[6,7,19] were included in this meta-analysis. The heterogeneity value was considerable and significant ($I^2 = 83\%$, $P = .003$). Children that loss anterior teeth presented higher risk of suffer speech distortion than children without tooth loss (RR 2.06 [1.21, 3.5] $P = .008$) (Figure 2) with very low certainty of evidence (Table 4).

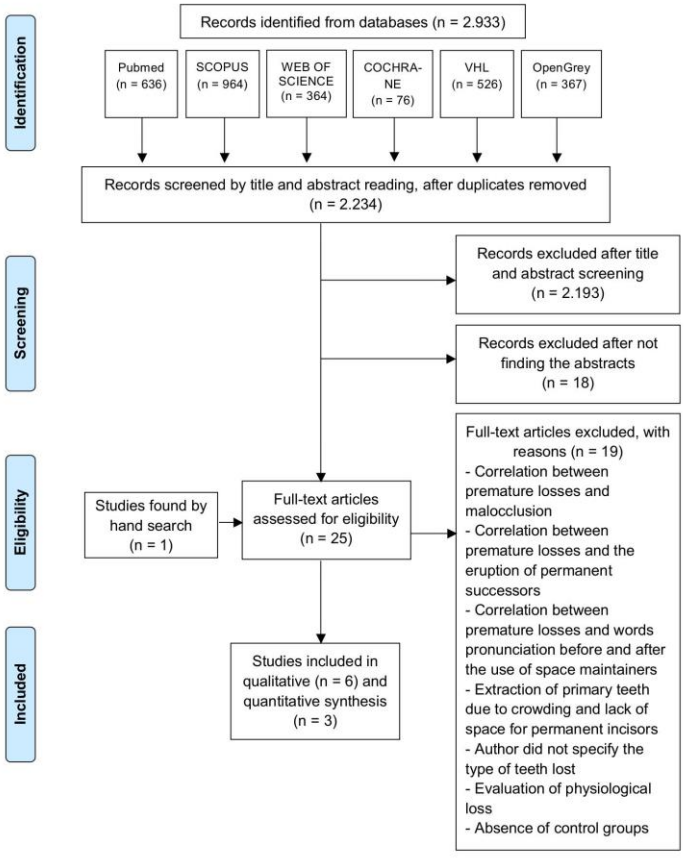

FIGURE 1 PRISMA flow diagram of the search results from the databases

TABLE 2 Description of included studies

Author, year, country	Study design	Age range	Age at loss moment	Sample size	Distribution of groups		Teeth affected	No. of teeth e xtracted/ lost
					Exposed	Not-exposed		
Adewumi, 2012 EUA	Observational, longitudinal, case-control	5-6 y	2-4 y	57 patients in parents interview 51 patients in speech evaluation	24 patients	27 patients	Maxillary primary incisors	Mean of 4 incisors
Gable, 1995 EUA	Observational, longitudinal, case-control	8-10 y Mean age = 9 y	Mean age = 3 y	52 patients	26 patients	26 patients	Primary central and lateral maxillary incisors	4 incisors

Extraction/ lost cause	Presence of the permanent successors erupted	Duration of the study	Evaluation moments	Evaluation criteria	Outcome	Conclusion
NR	NR – but probably yes	NR	One evaluation moment	**Speech evaluation:** Goldman-Fristoe test of articulation by a professional speech evaluation. The test consists of a set of well-defined pictures, the names of which contain each of the consonant sounds in the initial, medial, and final positions of words.	**Speech outcome – frequency (%):** Problems pronouncing 's' and 'z': loss – 6 (25%), no loss 3 (11%) (Fisher exact test; $P = .02$) Speech distortion: loss – 13 (54%)	Children with premature extraction of maxillary primary incisors showed disarticulation of 's' and 'z' sounds vs. those with intact incisors Children may also exhibit dentally unrelated speech distortions following premature extraction of maxillary primary incisors.
NR	Presence of the maxillary permanent incisors at the time of testing	NR	One evaluation moment	**Speech evaluation:** Photo Articulation Test to assess the production of all consonant sounds as well as three consonant blends. Most consonants were tested in the initial, medial and final words positions. Assessment of articulation at the sentence level was also conducted Articulation was evaluated by two graduate students and to establish rater reliability, 40% of the subjects were also rated by a speech-language pathologist.	**Speech outcome:** 12 of 26 subjects with premature loss and 13 of 26 control subjects produced some type of articulation error **Number of subjects that produced errors in Photo Articulation Test and ():** Sibilants distortions: loss – 29 (3), no loss – 8 (1) Fricatives substitutions: loss – 5 (4), no loss – 17 (8) Fricatives omissions: loss – 7 (7), no loss – 2 (2) Stops omissions: loss – 10 (5), no loss – 2 (2) Liquids substitutions: loss – 0, no loss – 11 (2) **Number of error productions in at least one word position on the sentence test and number of subjects in ():** Sibilants distortions: loss – 37 (4), no loss – 6 (1) Fricatives substitutions: loss – 9 (6), no loss – 14 (8) Stops omissions: loss – 1 (1), no loss – 1 (1) **Photo Articulation Test:** Speech distortion and (#Ss): loss – 51 (12), no loss – 40 (13) ($P > .05$) **Sentence test:** Total errors and (#Ss): loss – 47 (7), no loss – 21 (10) ($P > .05$) The actual number of subjects (#Ss) is represented	The premature loss group produced more articulation errors overall than the group with normal exfoliation. No statistically significant differences in error production were found between the groups.

(Continues)

TABLE 2 (Continued)

Author, year, country	Study design	Age range	Age at loss moment	Sample size	Distribution of groups		Teeth affected	No. of teeth e xtracted/ lost
					Exposed	Not-exposed		
Lamberghini, 2012 USA	Observational, retrospective, cohort	7-10 y	3-5 y	33 bilingual (Spanish-English) patients	25 patients	8 patients	Primary maxillary incisors	NR
Magnusson, 1979 Iceland	Two-part epidemiological study	NR	Unknown	46 patients	46 patients	Same patients – split mouth study	Primary canines and molars	Unilateral loss of one or more canines and molars
To, 1991 Hong Kong	Observational, longitudinal, cohort	0 y	0 y	48 natal teeth	32 extracted teeth	16 non-extracted teeth	Primary mandibular central incisors	One or two incisors

Extraction/ lost cause	Presence of the permanent successors erupted	Duration of the study	Evaluation moments	Evaluation criteria	Outcome	Conclusion
NR	Presence of the maxillary permanent incisors at the time of testing	NR	One evaluation moment	**Speech evaluation:** Examination of the speech of bilingual (Spanish-English) through Goldman-Fristoe Test of Articulation-2 (GFTA-2) by a speech pathologist who possessed over 25 y experience evaluating the speech sound articulation of children with orofacial and dental differences. Test consists of a set of well-defined pictures, the names of which contain each of the consonant sounds in the initial, medial, and final positions of words.	**Speech error – mean (SD) Mann-Whitney p-value:** Speech distortion errors: exposed: 10.1 (5.4), unexposed: 7.5 (5.0), *P*-value: .22 Dental errors: exposed: 4.68 (4.48), unexposed: 1.50 (3.85), *P*-value: .04 Dialectical errors: exposed: 3.96 (2.54), unexposed: 4.50 (2.14), *P*-value: .57 Other articulation errors including developmental errors: exposed: 1.44 (1.00), unexposed: 1.50 (2.07), *P*-value: .57	Hispanic bilingual children with premature tooth loss produced more articulation errors overall than Hispanic bilingual children with normal exfoliation Hispanic bilingual boys who suffered premature loss of their primary maxillary incisors produced significantly more speech sound errors than the Hispanic bilingual boys without exposure to tooth loss as well as the Hispanic bilingual girls with or without exposure to such loss.
NR	NA	4 y	T1 – initial recording of the loss T2 – about 4 y passedfrom the T1	**Space evaluation:** Alginate impressions, bite registration and radiographs were taken of the segments in which all the permanent teeth had not emerged Space in the dental arches was measured in the canine/premolar segment and in the incisor segments on the right and left side in the arches where premature loss had occurred.	**Space loss – mm:** Space difference when only canine was lost: Dental stage: D3: −0.1 mm in patient1 D4: −0.5 mm in patient2, 0.0 mm in patient3, −3.3 mm in patient4 — Results indicate comparative loss of space in mm on the side of premature tooth loss	Space loss is most marked in individuals who lose primary teeth prematurely at an early stage of dental development Part of the space lost during the stages of early dental development (DS 02, DS 1, and DS 2) is regained during the development of stages DS 3 and DS 4.
Hypermobility or tongue trauma	NA	Six months to 7 y – mean 3 y and 9 mo	T1 – one week after the extraction, T2 – 1 mo after the extraction, T3 – every 6 mo intervals.	**Space evaluation:** Cases in which natal teeth were extracted: A pair of dividers was used to measure the space left by the extracted teeth, to detect any space loss Cases in which natal teeth were not extracted: The appearance of the crown and any evidence of root formation were noted	Author did not present any information about the outcomes.	No appreciable space loss occurred following the extractions. Root development occurred in teeth that were not extracted, but the crowns were hypoplastic in three cases.

(Continues)

TABLE 2 (Continued)

Author, year, country	Study design	Age range	Age at loss moment	Sample size	Distribution of groups		Teeth affected	No. of teeth e xtracted/ lost
					Exposed	Not-exposed		
Turgut, 2012 Turkey	Observational, longitudinal, case-control	3-5 y	NR	30 patients	15 patients	15 patients	Primary maxillary incisor	One to 4 incisors

Abbreviations: NA, not applicable; NR, not reported; SD, standard deviation.

3.4.2 | 2nd meta-analysis: Omission speech problems

Two studies[6,19] were included in the second meta-analyses. The heterogeneity values were null ($I^2 = 0\%$, $P = .47$) and not important ($I^2 = 1\%$, $P = .32$), respectively, for meta-analysis A and B (Figure 3). Pooled results of both analyses showed the same results: children presenting anterior tooth loss presented similar risk of suffering speech omission than children without tooth loss (RR (A) 1.75 [0.54, 5.71] $P = .35$ and RR (B) 2.25 [0.73, 6.94] $P = .18$) (Figure 3) with very low and low certainty of evidence, respectively (Table 4).

3.4.3 | 3rd meta-analysis

Three studies[6,7,19] were included in the third meta-analyses. The heterogeneity values were null ($I^2 = 0\%$, $P = .49$) and moderate but not significant ($I^2 = 0\%$, $P = .19$), respectively, for meta-analysis A and B (Figure 4). Pooled results of both analyses showed the same results: children with anterior tooth loss presented similar risk of suffering speech substitution than children without tooth loss (RR (A) 1.47 [0.83, 2.59] $P = .19$ and RR (B) 1.10 [0.66, 1.82] $P = .72$) (Figure 4) with very low certainty of evidence in both analysis (Table 4).

4 | DISCUSSION

If on one hand, the consequences of premature loss of primary posterior teeth are widely studied and a varied range of devices has been developed to prevent space loss occurrence; on the other hand, there is little scientific evidence published in the literature evaluating the sequelae of premature loss of primary anterior teeth.

For the best of our knowledge, this is the first systematic review and meta-analysis considering the outcomes of early loss of primary anterior teeth. The majority of primary articles retrieved in this study evaluated phonation impairment in children that lost their maxillary primary incisors through speech and language tests[6-8,19]; and only two of the four studies provided information about dental arch space loss.[20,21]

To consider all the available evidence, the search strategy included the whole possibility of synonyms for the population: primary anterior teeth, incisors, and canines; for the exposition: tooth loss and tooth extraction; and for the outcome, including the consequences related to speech impairment or space loss in dental arches. From this, one meta-analysis was conducted investigating the relationship between premature loss of primary incisors and the development of speech disorders. All of the included articles were observational studies.[6-8,19] It was not possible to perform a space loss

Extraction/ lost cause	Presence of the permanent successors erupted	Duration of the study	Evaluation moments	Evaluation criteria	Outcome	Conclusion
Early childhood caries	N R	One week	T1 – before extraction of the primary teeth, T2 – after extractions were completed and haemorrhage control, T3 - 2 wk after extraction and before insertion of the dentures, T4 – just after insertion of the dentures, T5 – at 1 wk after insertion of the dentures (follow-up appointment)	**Speech evaluation:** Ankara Articulation Test (AAT) and by talking about subjects that the child was interested in by a speech therapist. The test evaluates the pronounce of the consonants (except for 'g') in the initial, medial, and final word positions according to the following errors: omission, substitution, addition, distortion, interdental lisping, and mass effect	**Speech outcome – number of errors (%):** Case group – 2 wk after extraction: Normal: 277 (92.3), Distortion: 2 (0.7), Substitution: 18 (6.0), Omission: 2 (0.7), Interdental lisping: 1 (0.3), Addition: 0 Control group: Normal: 282 (94.0), Distortion: 0, Substitution: 15 (5.0), Omission: 2 (0.7), Interdental lisping: 0, Addition: 1 (0.3)	There was no significant difference when a comparison was made in the errors between the case group before extraction and those of the control group ($P = .427$). There was no significant difference when a comparison was made between the errors of the case group before and after tooth extraction ($P = .317$)

meta-analysis since only one article presented results on this subject.[21]

The risk of bias assessment of the included articles evaluated aspects of study design, corresponding to the internal validity. The methodological quality was evaluated through the ROBINS-I tool for observational studies.[17] Considering this guideline, all the articles presented certain methodological limitations. Therefore, the results of the review need to be evaluated with caution. Positively, despite this, the heterogeneity between the studies was not significant.

Furthermore, some criteria were considered potential confounding factors for the studies since they could influence their outcome: malocclusion, deleterious habits, and previous history of speech problems. Individuals with malocclusion should be excluded from the reports since they present more difficulty in articulation of dental sounds than those with normal occlusion.[22-24] Individuals with deleterious habits including pacifier suction, finger suction, and tongue interposition should also be excluded as they can originate articulation speech disorders and they may also develop anterior open bite. This occlusal feature is the most often associated with disarticulations.[24] And obviously, individuals with previous history of speech disorders should also be eliminated.

Teeth, in combination with lips and tongue, play an important role in the articulation of consonants by airflow obstruction and modification. Thus, tooth position or tooth absence may cause articulatory speech disorders.[25] These articulation disorders are believed to occur when the child has difficulty to produce the movements associated with the production of a sound[26,27]—the child omits, makes substitutions, distortions or additions of sounds. Omission is characterized by the absence of the target sound in the production of the word; substitution is identified when the target sound is replaced by another sound in the production of a word; and distortion is recognized when there is a mispronunciation of a target sound in a word.[28] One of the possible reasons for incorrect production of sounds includes physical discrepancies of the lips, mandible, tongue, palate, and teeth.[29]

In order to investigate whether the premature loss influenced in the emergence of these speech disorders three meta-analyses were performed—the first for distortion, the second for substitution and the third for omission. *According to Borenstein et al,[30] the random effect model should generally be the model used when studies are pooled from the literature. However, if the universe is defined broadly and there is little number of studies, such as two or three, this model becomes flawed. In these situations, the fixed-effects model can be applied, as well as it was adopted in the present meta-analysis. However, it is necessary to highlight that these results cannot be generalized beyond them to any other studies. Then, authors of the present study encourage the development of more studies with valid methodological assessment of*

TABLE 3 Assessment of bias for each study, using the ROBINS-I bias tool for observational studies

Observational studies			
Author, year	**Confounding**	**Selection of participants into the study**	**Classification of observations**
Adewumi, 2012	Serious – At least one known important domain was not appropriately controlled – author did not exclude patients with malocclusion and deleterious habits 'Children with speech, learning, developmental, or any type of cognitive delay, those with autism, cleft lip and/or palate, or craniofacial syndromes affecting speech were excluded from participating in the study. Patients who were not fluent in English were also excluded from the study'	Low – All participants who would have been eligible for the target trial were included in the study. 'Dental records of healthy 5- to 6-y-olds who received premature extractions of their primary maxillary incisor teeth between 2005 and 2007 at the University of Florida College of Dentistry (UFGD) were identified. (…) A matched group of healthy children of similar age and socioeconomic status, with intact primary maxillary incisors and who received routine dental treatment at the pediatric dental clinics of the UFGD, were recruited for speech evaluations as controls'.	Moderate – Some aspects of the assignments of observation status were determined retrospectively since patients were collected from records. 'Dental records of healthy 5- to 6-y-olds who received premature extractions of their primary maxillary incisor teeth between 2005 and 2007 at the University of Florida College of Dentistry (UFGD) were identified'
Gable, 1995	Critical – Confounding inherently not controllable, such as speech problems, malocclusion and deleterious habits.	Moderate – Selection into the study was not from all eligible patients. 'Twenty-six children, with a history of premature loss due to extraction of the central and lateral maxillary incisors, were selected from the dental records of the Division of Pediatric Dentistry of Children's Hospital Medical Center in Cincinnati, Ohio. Criteria for selection of these subjects included a history free of medical complications all twenty-six subjects had lost the four maxillary primary incisors by means of age of extraction before the age of five. All subjects had their four maxillary permanent incisors at the time of testing. The subjects age ranged from 8 y and 1 mo to 10 y and 11 mo at the time of this study (…) Twenty-six subjects with a history of normal exfoliation of their four maxillary primary incisors served as the comparison group. All of these subjects also had their maxillary permanent incisors at the time of testing. These subjects were randomly selected at the Division of Pediatric Dentistry and outpatient departments of Children's Hospital Medical Center in Cincinnati, Ohio and ranged in age from 8 y and 1 mo to 10 y and 11 mo'	Moderate – Some aspects of the assignments of observation status were determined retrospectively since patients were collected from records. 'Twenty-six children, with a history of premature loss due to extraction of the central and lateral maxillary incisors, were selected from the dental records of the Division of Pediatric Dentistry of Children's Hospital Medical Center in Cincinnati, Ohio'

Deviations from intended observation	Missing data	Measurement of outcomes	Selection of the reported result	Overall risk of bias
No information – Author did not report any deviations from intended observation such as receipt of speech therapy, use of space maintainer, etc	Low – Data were reasonably complete.	Moderate – Absence of blindness and kappa. 'Children whose parents gave consent (experimental group) were evaluated by a trained speech and language pathologist using the Goldman-Fristoe test of articulation (GFTA). The GFTA is a standardized test, which focuses on most dentally articulated consonants such as v, f, th, s, and z'	Moderate – Author evaluated sounds of 'v','f', 'th', 's', 'z' but reported only results regarding 's' and 'z'. There is no clear evidence that all reported results correspond to all intended outcomes and analyses	Serious
Critical – There was a substantial deviation from usual practice that was unbalanced 'Two of the twenty-six subjects with premature loss had received speech therapy, both for less than 3 mo. Five of the twenty-six subjects with normal exfoliation of their incisors had received speech therapy for an average of 2 y, 6 mo'. 'Fifty-five percent of the subjects in the premature loss group who presented with malocclusion produced no articulatory errors. Four other members of this group presented with just a few errors. Only one subject, who had a mixed occlusal relationship, produced one sibilant distortion. Three subjects in the comparison group were found to have malocclusions'	Low – Data were reasonably complete.	Low –'The occlusion was evaluated by a dentist and recorded according to incisor relationship and Class I, Class II, or Class III molar relationship. (…) Incisor relationship of deep over-bite, crossbite, and openbite were also noted. (…) Articulation was evaluated by two graduate students. (…) The Photo Articulation Test was administered in order to assess the production of all consonant sounds as well as three consonant blends (…) A total of seventy-six possible phonemic productions were assessed on this test. Assessment of articulation at the sentence level was also conducted. (…) On this sentence test, a total of thirty-eight phonemic productions were tested'	Low – There is clear evidence that all reported results correspond to all intended outcomes and analyses.	Critical

(Continues)

TABLE 3 (Continued)

Observational studies			
Author, year	**Confounding**	**Selection of participants into the study**	**Classification of observations**
Lamberghini, 2012	Serious – At least one known important domain was not appropriately measured or not controlled. In this case, the author did not control the presence of deleterious oral habits. However, other important confounding domains were appropriately controlled 'At this time, children were excluded if they: had a history of systemic disease or hearing impairment; presented with severe skeletal discrepancy or other maxillofacial anomalies; had a history of participation in speech therapy; or presented with urgent dental care needs'.	Low – All participants who would have been eligible for the target trial were included in the study 'This retrospective cohort study was approved by the Institutional Review Board (protocol no. 2005-0259) of the University of Illinois at Chicago (UIC). To enable comparisons between bilingual children with premature tooth loss and those without, a cohort of 7- to 10-y-old bilingual (Spanish-English) children was sought from children seen in UIC's Department of Pediatric Dentistry. These children were identified from existing records at the College of Dentistry showing children who had premature tooth loss (early maxillary incisor extraction) between 3 and 5 y old. (…) When the children arrived for their study appointment, it was verified that they were medically healthy and presented with 4 permanent maxillary incisors. At this time, children were excluded if they: had a history of systemic disease or hearing impairment; presented with severe skeletal discrepancy or other maxillofacial anomalies; had a history of participation in speech therapy; or presented with urgent dental care needs'	Moderate – Some aspects of the assignments of observation status were determined retrospectively since patients were collected from records 'These children were identified from existing records at the College of Dentistry showing children who had premature tooth loss (early maxillary incisor extraction) between 3 and 5 y old'.

Deviations from intended observation	Missing data	Measurement of outcomes	Selection of the reported result	Overall risk of bias
No information – Author did not report any deviations from intended observation such as receipt of speech therapy during the observation. The co-intervention of history of participation in speech therapy was controlled only in the pre-observation.	No information	Low – The methods of outcome assessment were comparable across observation groups 'A 77-item, standardized speech sound articulation test [the Goldman-Fristoe Test of Articulation-2] was then administered in English to each child by a speech pathologist who possessed over 25 y experience evaluating the speech sound articulation of children with orofacial and dental differences. This tester was blinded to the children's exposure category. (…) A random sample of recordings for 30% of the participants (N = 10) was re-evaluated by the speech pathologist to establish intraexaminer reliability (correlation coefficient r = .92)'	Low – There is clear evidence that all reported results correspond to all intended outcomes and analyses.	Serious

(Continues)

TABLE 3 (Continued)

Observational studies			
Author, year	**Confounding**	**Selection of participants into the study**	**Classification of observations**
Magnusson, 1979	No information.	Low – All participants who would have been eligible for the target trial were included in the study 'The first part, the diagnosis and registration of premature loss of primary teeth and space anomalies, was part of an epidemiological registration of malocclusion (Magnusson, 1976b) from September 1972 to May 1973. A random sample of 1648 children from all classes of all schools in Reykjavik was obtained by identifying all the children in the primary and secondary schools of Reykjavik in October 1972 whose birthdays were on the 7th, 17th or 27th of each month. All but seven of these children (0.4%) were subsequently examined. The 1641 children (791 boys and 850 girls) represented 9.5% of all the children attending primary and secondary schools in Reykjavik at that time. (…) Of the children in DS 02, DS 1 and DS 2 who had premature loss of primary teeth, 55 had unilateral loss of one or more primary canines or molars from the maxilla or the mandible. Part II of this study, undertaken in 1976/77, was based on a follow-up examination of this group of 55 children'.	Low – Observation definition is based solely on information collected at the time of observation 'Of this group 1166 children (550 boys and 616 girls) representing those in stages DS 3 (canine and/or premolars erupting) and DS 4 (canines and premolars fully erupted) were omitted from the material. The estimation of influence of premature loss of primary teeth on the spacing of the permanent dentition is doubtful in DS 3 and impossible in DS 4. Therefore 519 children (267 boys and 252 girls) in dental stages DS 02 (primary teeth fully erupted), DS 1 (permanent incisors erupting) or DS 2 (permanent incisors fully erupted) formed the basis of the present material. A detailed account has already been given of the children selected for the study (Magnusson, 1976a, 1976b). Premature loss of primary teeth was recorded only if it conformed to the definition of Bjork et al (1964)—'The succeeding permanent tooth shall not have penetrated the mucous membrane nor be palpable immediately beneath it'. No other missing primary teeth were recorded. (…) In this study the precise time of premature loss was unknown…' Some aspects of the assignments of observation status were determined in a rather dubious way.

Deviations from intended observation	Missing data	Measurement of outcomes	Selection of the reported result	Overall risk of bias
Moderate – The deviations were not controlled and it may have affected the outcome 'In this study the precise time of premature loss was unknown (…) The possibility that some of the children may have lost one or more additional primary teeth between the initial and follow-up examinations cannot be excluded'.	Moderate – Proportions of missing participants is slightly – the loss is lower than 20% 'Part II of this study, undertaken in 1976/77, was based on a follow-up examination of this group of 55 children. Four of them were not available for re-examination so the material for the second part of the study consisted of the remaining 51 children who were by then in DS 2, DS 3 or DS 4. (…) Three children were excluded because the first molars had been lost and a further 2 were excluded because radiographs showed that they had congenital absence of premolars. The sequelae of premature loss of primary teeth were therefore assessed on a group of 46 children (27 boys and 19 girls)'	Moderate – The methods of outcome assessment were comparable across observation sites 'Alginate impressions and bite registration were made and radiographs were taken of the segments in which all the permanent teeth had not emerged. (…) Space in the dental arches was measured in the canine/premolar segment and in the incisor segments on the right and left side in the arches where premature loss had occurred Measurements were made with a sliding caliper to an accuracy of 0.1 mm. (…) All measurements were made twice by the author and this showed that the error was less than 5%'.	Low – There is clear evidence that all reported results correspond to all intended outcomes and analyses.	Moderate

(Continues)

TABLE 3 (Continued)

Observational studies			
Author, year	**Confounding**	**Selection of participants into the study**	**Classification of observations**
To, 1991	Low – no confounding expected at the study baseline due to the patients being newborns. Confounding such as malocclusion, deleterious habits and history of speech therapy are impossible to exist in newborns.	Low – All participants who would have been eligible for the target trial were included in the study 'The study involved babies born at the Queen Elizabeth Hospital, Hong Kong between January 1984 and December 1988. When medical officers of the Obstetrics and Gynaecology Unit detected an abnormality in a newborn baby's mouth they informed the dental staff'.	Low – Observation definition is based solely on information collected at the time of observation 'At the initial examination, the number, position, appearance and mobility of the natal teeth were noted. (…) It was decided to extract natal teeth of category 1, and those of category 2 if the degree of mobility was more than 2 mm. The extractions were performed under local analgesia. A curved artery forceps was used and a finger or a piece of gauze was placed behind the tooth to prevent its inadvertent displacement into the throat. After extraction, finger pressure was used to achieve haemostasis and the child was kept under observation for 24 hours. (…) Cases in which natal teeth were extracted: A pair of dividers was used to measure the space left by the extracted teeth, to detect any space loss. Cases in which natal teeth were not extracted: The appearance of the crown and any evidence of root formation were noted'.
Turgut, 2012	Serious – At least one known important domain was not appropriately controlled – author did not exclude patients with speech, learning, developmental, or any type of cognitive delay. 'Uncooperative children during the test procedures and those unable to use dentures were excluded from the study. The mother tongue of all of the subjects was Turkish, and they had no medical problems and had normal hearing. No evaluation was made regarding the articulations of the patients before the commencement of the study None of the patients had previously received speechTherapy'.	Moderate – Authors did not mention the sampling method and the source of sample – from where were the patients, for example 'In the beginning of the study, a total of 33 children, 3-5 y of age and diagnosed with ECC, participated in the case group. Nevertheless, 11 patients before extraction, 6 patients after extraction, and 1 patient after insertion of the dentures failed to Keep appointments. Thus, a total of 15 patients, 3-5 y of age (156.42-260.71 wk of age, mean age of 199.87 Å} 34.49 wk), were included in the case group. The control group consisted of 15 children, 3-5 y of age (160.77-278.09 wk of age, mean age of 227.39 Å} 40.68 wk), with intact anterior teeth'.	Low – Observation definition is based solely on information collected at the time of observation 'In the beginning of the study, a total of 33 children, 3-5 y of age and diagnosed with ECC, participated in the case group. Nevertheless, 11 patients before extraction, 6 patients after extraction, and 1 patient after insertion of the dentures failed to Keep appointments. Thus, a total of 15 patients, 3-5 y of age (156.42-260.71 wk of age, mean age of 199.87 Å} 34.49 wk), were included in the case group. The control group consisted of 15 children, 3-5 y of age (160.77-278.09 wk of age, mean age of 227.39 Å 40.68 wk), with intact anterior teeth'.

Deviations from intended observation	Missing data	Measurement of outcomes	Selection of the reported result	Overall risk of bias
No information – Author did not report any deviations from intended observation such as receipt of speech therapy, use of space maintainer, etc	Low – Data were reasonably complete.	Serious – The methods of outcome assessment were not comparable across observational groups and the author did not report how was the space loss measurement. 'Cases in which natal teeth were extracted: A pair of dividers was used to measure the space left by the extracted teeth, to detect any space loss Cases in which natal teeth were not extracted: The appearance of the crown and any evidence of root formation were noted'.	Critical – There is evidence of selective reporting of results. The author did not report the space loss results.	Critical
No information – Author did not report any deviations from intended observation such as receipt of speech therapy.	Low – Data were reasonably complete.	Low – The methods of outcome assessment were comparable across observation group 'Articulations of the patients were evaluated by one speech therapist who was experienced in the speech therapy of preschool children. Articulation was assessed using a standardized articulation test (Ankara articulation test, Ankara Artikülasyon Testi, AAT) and by talking about a subject that the child was interested in. (…) The remaining consonants were tested in the initial, medial, and final word positions according to the following errors'	Low – There is clear evidence that all reported results correspond to all intended outcomes and analyses.	Serious

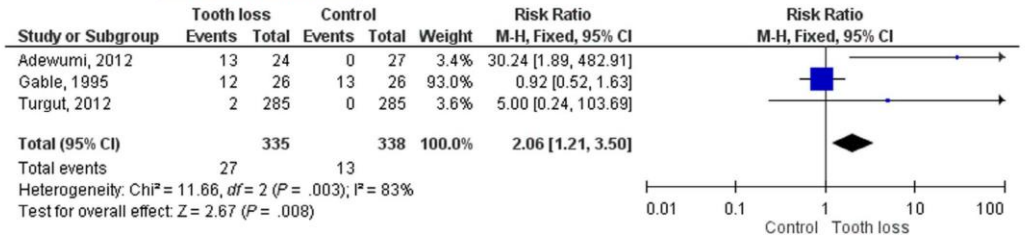

FIGURE 2 Forest plot of speech distortion

the risk of children to develop speech problems after anterior tooth loss.

Results from the 1st meta-analysis showed that children with premature loss of primary anterior tooth presented higher chance of develop distortion when compared to children without tooth losses. The results of the 2nd and the 3rd were not statistically significant. These last outcomes could be explained since substitution and omission are considered cognitive-linguistic processing deficits[31] and not a local difficulty.

The association of speech distortion and premature loss of anterior teeth obtained as a result of the 1st meta-analysis are in accordance with previous evidence, which has indicated that early loss of maxillary primary incisors may product distortion of certain consonants since their correct production requires forcing the air stream through an opening in the oral cavity small enough to produce friction noises.[32,33]

This finding emphasizes the need for attention to children who suffer premature loss of primary anterior teeth through follow-up consultations and treatment with speech therapy and/or space maintainer. Nevertheless, there are still two conflicting scientific thoughts concerning the use of space maintainers for anterior premature loss. Those who oppose to space maintenance claim that the spaces of early loss may be lost or not. When spaces are not lost, the installation of a space maintainer is dispensed, while, in the cases of negative arch discrepancy, patients already require orthodontic treatment for space recovery, regardless of the arch perimeter reduction that occurred due to premature losses.[34,35] Differently, those who favour the use of space maintainers believe that spaces that are lost prematurely are usually lost permanently, and deleterious effects caused in the speech and arch perimeter could be avoided with the use of an aesthetic appliance.[36]

In regard to speech evaluation criteria, the most frequently articulation and phonology assessment instrument used was the Goldman-Fristoe Test of Articulation-2nd Edition (GFTA-2). The GFTA-2 is a widely used standardized instrument that assesses consonant and consonant blend phonemes in various phonetic positions and contexts.[37] The use of GFTA-2 is highlighted because the test was 'designed to provide a controlled sample of a child's spontaneous production in words of the most frequently occurring consonant sounds in Standard American English'.[37] The phonemes assessed by the GFTA-2 were chosen to represent the wide range of consonant sounds, not by how well they discriminated performance. In addition, the GFTA-2 scoring system weighs each phoneme equally, despite the variations in ages at which they are typically developed or their impacts on intelligibility. These features are similar to other tests based on classical test theory.[38]

Regarding dental characteristics, the type of tooth most frequently assessed was maxillary primary incisor.[6-8,19] These studies were focused on the evaluation of speech disorders, so that the maxillary incisors have to be the type of tooth studied since they play an important role in phonation, being extremely important for the pronunciation of certain consonants such as: 'd', 'f', 'n', 's', 't', 'v'.[39]

Although it was not possible to carry out a meta-analysis evaluating the space closure, it is important to note that the premature loss of primary anterior teeth may lead to loss of anterior space, mainly if it occurs prior to the eruption of primary canines. In addition, there are other factors that might also influence space loss, such as Baume primary dental arch type and the presence of deleterious habits, among others.[12] Unfortunately, the studies included in the systematic review evaluated the occurrence of space loss after premature loss but they did not take into account the eruption of primary canines, primary dental arch type, or the presence of non-nutritive habits.[20,21]

Despite the above-mentioned information, there are few studies published in the literature investigating the consequences of premature loss/extraction of primary anterior teeth.[40] Additionally, these published studies have generally important methodological limitations with low-level evidence-based quality and outdated literature. Although the present meta-analysis showed that premature loss of primary anterior teeth may cause speech distortion, new controlled observational studies with high methodological quality should be performed in order to show the sequelae of premature loss of primary incisors and canines to the speech pattern and the space loss in the dental arches.

TABLE 4 Certainty of evidence

Certainty assessment						№ of patients		Effect		
№ of studies Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	With anterior tooth loss	Without anterior tooth loss	Relative (95% CI)	Absolute (95% CI)	Certainty
Distortion speech problems										
3 observational studies	Serious[a]	Serious[b]	Not serious	Very serious[c,d]	Strong association	27/335 (8.1%)	13/338 (3.8%)	**RR 2.06** (1.21 to 3.50)	**41 more per 1.000** (from 8 more to 96 more)	⨁◯◯◯ VERY LOW
Omission speech problems (a)										
2 observational studies	Serious[a]	Not serious	Not serious	Very serious[c,d]	None	7/311 (2.3%)	4/311 (1.3%)	**RR 1.75** (0.54 to 5.71)	**10 more per 1.000** (from 6 fewer to 61 more)	⨁◯◯◯ VERY LOW
Omission speech problems (b)										
2 observational studies	Serious[a]	Not serious	Not serious	Very serious[c,d]	Strong association	9/311 (2.9%)	4/311 (1.3%)	**RR 2.25** (0.73 to 6.94)	**16 more per 1.000** (from 3 fewer to 76 more)	⨁⨁◯◯ LOW
Substitution speech problems (a)										
3 observational studies	Serious [a]	Not serious	Not serious	Very serious[c,d]	None	26/350 (7.4%)	18/353 (5.1%)	**RR 1.47** (0.83 to 2.59)	**24 more per 1.000** (from 9 fewer to 81 more)	⨁◯◯◯ VERY LOW
Substitution speech problems (b)										
3 observational studies	Serious[a]	Not serious	Not serious	Very serious[c,d]	None	28/350 (8.0%)	26/353 (7.4%)	**RR 1.10** (0.66 to 1.82)	**7 more per 1.000** (from 25 fewer to 60 more)	⨁◯◯◯ VERY LOW

Abbreviations: CI, confidence interval; RR, risk ratio.

[a]All included studies were considered with moderate or high risk of bias.

[b]Considerable heterogeneity.

[c]Upper and lower limits of confidence interval were >25%.

[d]Number of events are lower than 300.

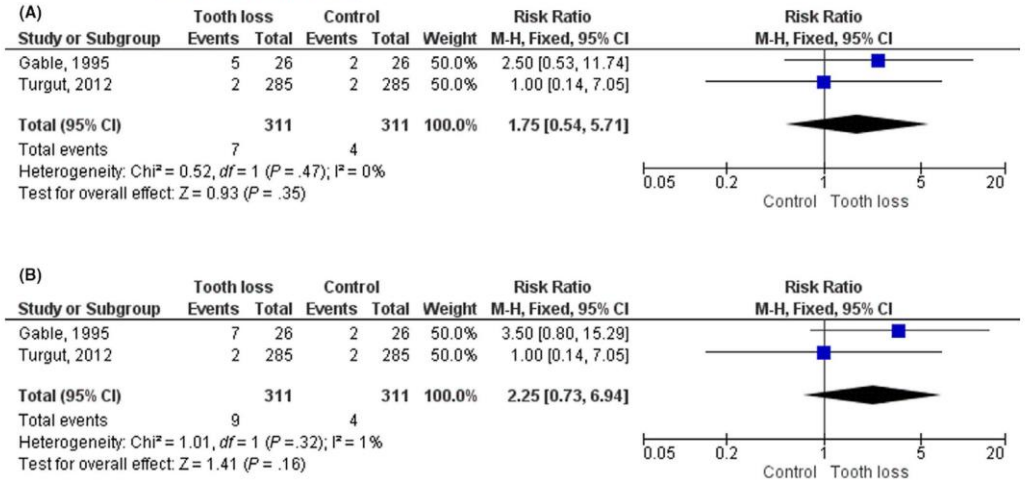

FIGURE 3 Forest plots of speech omission

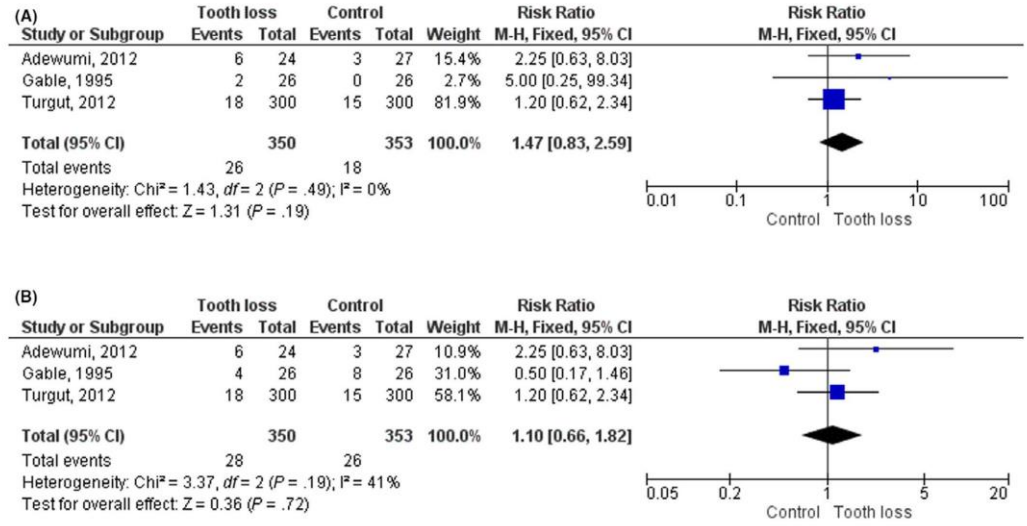

FIGURE 4 Forest plot of speech substitution

5 | CLINICAL RELEVANCE

The consequences of premature loss of primary posterior teeth are well established in the literature, although the effect of premature loss of primary anterior teeth is controversial and not completely elucidated. Moreover, due to the lack of scientific evidence, dental professionals rely on clinical experiences to decide the clinical management. Clinical decisions, however, should, whenever possible, be made based on scientific evidence. Our systematic review and meta-analysis bring the available evidence on the subject.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest concerning this article.

AUTHORS' CONTRIBUTIONS

PN, NB, and MBM collected and analysed the data; DM assisted in conducting the strategy search; PN led the writing; ACRC and LCM guided the study.

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4.2 Artigo 2: Does the premature loss of primary anterior teeth cause morphological, functional and psychosocial consequences?

CRITICAL REVIEW
Pediatric Dentistry

Does the premature loss of primary anterior teeth cause morphological, functional and psychosocial consequences?

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Abstract: Premature loss of primary anterior teeth in deciduous arches is a controversial topic in the literature, especially due to the lack of robust scientific evidence regarding the types and magnitudes of the consequences involved. Morphological, functional, and psychosocial problems may arise from untreated premature loss of primary incisors and canines. The morphological problems include impaction and eruption disturbances of permanent successors; inclination and/or extrusion of adjacent and antagonist teeth, respectively; midline deviation; and crowding. Functional complications, such as speech disorders, aesthetic problems, and development of non-nutritive habits may occur, resulting in psychosocial implications, including a decrease in self-esteem, and even being targeted for bullying. The current critical review aimed to present and discuss the evidence available in the literature about the etiology, characteristics, implications and interventions resulting from the premature loss of primary anterior teeth. It is of utmost importance that future studies be developed to support the clinical decisions made by dental professionals on this topic.

Keywords: Incisor; Cuspid; Tooth, Deciduous; Tooth Avulsion; Tooth Extraction.

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Introduction

Primary dentition plays critical morphological, functional and psychosocial roles in child development, by providing proper conditions for skeletal and muscular growth, establishment of occlusion, mastication, phonation and aesthetics[1]. Furthermore, maintaining deciduous arch integrity exerts a strong influence on developing permanent dentition, conserving dental arch length, and retaining the space needed for successor teeth to erupt.[1]

The time during which primary tooth loss endures is a major factor to be considered. Although it has been reported that tooth loss is considered premature when it occurs at least one year before the normal exfoliation period,[2] the approach of estimating tooth eruption according to dental age is considered a more reliable method than using the child's chronological age.[3] According to Nolla's radiographic assessment of dental age, primary

tooth loss is considered premature when the successor permanent tooth has still not developed beyond Nolla's stage six, in which coronary formation is completed and eruptive movements are initiated.[3]

The premature loss of primary teeth is considered an oral health problem, owing to associated aspects of functional and psychological damage[4]. The most common etiologies are related to trauma, advanced dental caries, neonatal tooth extraction and premature root resorption.[4,5,6]

Sequelae resulting from premature loss of anterior teeth may affect a patient's speech evolution;[7,8,9,10] development and eruption of permanent successor teeth;[11] establishment of malocclusion in permanent dentition;[12] arch integrity;[13,14,15] and onset of non-nutritive habits.[16,17] When present, these consequences may require intervention with space maintainers.[18] Nevertheless, there are two divergent viewpoints regarding space maintenance in the anterior area, whereas the former supports the use of oral appliances,[19,20] the latter disagrees with this recommendation[21,22]. Those who support the use of space maintainers believe that premature loss can cause space loss in dental arches, and that this can be prevented with space maintenance.[19,20] On the other hand, those who oppose the use of space maintainers argue that the spaces resulting from premature tooth loss may be unaffected, and that a space maintainer may therefore by dispensed with.[21,22] In addition, from the perspective of these authors, patients with negative arch discrepancies might require orthodontic treatment, regardless of the arch perimeter impairment due to the premature loss.[21,22] Lastly, these authors also discuss that many lost spaces are recovered when the permanent successor erupts.[21,22]

Despite our previous knowledge of the topic, the authors still find that issues, such as the amount of space change in dental arches, and the dental and skeletal consequences that follow the premature loss of anterior teeth, are not sufficiently understood. Additionally, the available data on the psychosocial effects of such loss on children's and parents' quality of life, aesthetics,[23] and phonation are also unsatisfactory.[24,25] In this respect, the purpose of this critical review was to present and discuss the evidence available in the literature concerning etiology, diagnosis, implications and interventions following the premature loss of primary anterior teeth.

Methodology

This revision was based on a PubMed/Medline search using MeSH terms, synonyms and key words related to primary anterior teeth and tooth loss, chosen specifically to avoid any restriction, and to maximize the search field in this research phase. No restriction on language or publication data was placed on the search strategy. Studies with different designs were included, such as observational studies, case series, literature reviews, and systematic reviews, among others. Articles published up to April 2020 were considered for this critical review. A manual search was also performed on the reference lists of the selected articles. The studies were selected based on evaluation of the titles and abstracts of all the studies identified in the electronic database.

Full articles were read and the data were extracted to perform the critical review. The information extracted from the selected studies was defined in order to gather and synthesize the key information. The following data were extracted from the studies: study subjects, objectives, methodology, results and main conclusions of each study. When the data did not appear to be sufficient or was inconclusive, the critical analysis was based on expert and/or consensus opinion by experienced researchers.

The confidence in selecting the results of a certain study depends on the study design and the level of evidence; to this end, the present review comprised a broad analysis of the literature, to encourage discussions about study methods and results, as well as reflections on future studies. The ultimate goal was to gain a sufficient body of knowledge on the investigated topic.

Results and discussion

Etiology of premature loss of primary teeth

The etiology of premature loss of posterior teeth is usually associated with advanced dental caries[26], whereas premature loss of anterior teeth is related to

dental trauma, dental caries, neonatal tooth extraction and premature root resorption[5,6].

Regarding dental trauma, a previous meta-analysis showed a 22.7% worldwide prevalence of traumatic dental injuries in primary teeth[27]. Premature loss of primary anterior teeth due to avulsion ranges between 5.8% and 19.4%,[23] and frequently occurs in children aged 2–4 years. In addition, premature loss of primary anterior teeth can result from an extraction after injury based on poor prognosis, late complications, early exfoliation following accelerated root reabsorption, intrusion, root fracture, and several different types of luxation injuries.[23,28]

Regarding dental caries, despite the decline in its incidence improved by preventive programs, a significant number of children still develop this disease[29]. A previous systematic review revealed that the prevalence of dental caries among 5-year-old children ranged from 22.9%[30] to 90%.[31] It is worth mentioning that the wide-ranging discrepancy in dental caries prevalence globally reflects the diversity of the many countries of origin of the studies included in this systematic review,[32] and that dental caries in preschool children still remains prevalent in most nations worldwide.[32] Caries may cause premature tooth loss when lesion progression is advanced, and endodontic tooth treatment is not recommended due to accelerated root reabsorption or when rubber dam isolation cannot be performed, then the tooth must be extracted.[29,32,33]

Other etiological factors related to premature loss of primary anterior teeth are natal and neonatal teeth, described as those already present in the baby's oral cavity at the moment of the birth, and those that appear in the oral cavity during the first month of life, respectively.[15] The proportion of natal or neonatal teeth ranges from close to 0 to 1:10 cases.[34] Premature extraction of these teeth is normally indicated, owing to the relevant clinical mobility due to the absence of root formation and inadequate tooth implantation.[35] Such faulty implantation could result in tooth displacement, and subsequent swallowing or aspiration by the baby; this concern fully warrants tooth extraction.[36] Additionally, in some cases, primary tooth extraction might be necessary, because of a child's inability to accept long restorative or endodontic dental treatments, or else the parents' refusal to approve complex treatments, including lengthy endodontic procedures.[23]

It is also worth mentioning that premature loss of primary anterior teeth might result from root resorption due to tooth size discrepancies between primary and permanent teeth, particularly in crowded dental arches.[5] The most frequently affected teeth include primary lower canines and upper lateral incisors, followed by upper canines, lower lateral incisors, and second molars.[5]

Premature loss of primary anterior teeth

Incisors

Premature loss of primary anterior incisors is usually caused by traumatic dental injuries.[23] Loss of a primary incisor is more commonly observed in the maxilla than in the mandible.[38] On one hand, the premature loss of maxillary incisors has minimal impact on mastication or other functions, and the space loss is usually insignificant, unless the teeth are lost at a very young age, or in case of associated crowding, excessive overjet or deep overbite malocclusions.[38] On the other hand, the main consequences reported are incisive function impairment, speech problems, including distortion and articulation errors during the pronunciation of consonants,[8] and aesthetic issues.[23]

Regarding the number of incisors lost or extracted, it has been suggested that, if just one central incisor is lost at an early age (Figure 1), no major dental arch changes are expected, except for a possible slight midline deviation[39]. However, when both central incisors are lost (Figure 2), it has been reported that there is no significant impact on arch perimeter, but that there is a possibility that deleterious habits such as tongue thrusting[39] may be established. When central and lateral incisors are lost prematurely (Figure 3), the consequences of establishing deleterious oral habits may be greater, in addition to other outcomes, like extrusion of lower incisors to compensate the lack of contact with opposing teeth.[39]

Figure 1. Patient M.A.F.S., male, 5 years old, unilateral premature loss of primary central incisor (61). Intraoral frontal photograph 3 years after premature tooth loss. (Image by Patricia Nadelman PhD student - CVMT/FO-UFRJ®)

Figure 2. Patient I.G.L., female, 5 years old, bilateral premature loss of primary central incisors (51 and 61). Intraoral frontal photograph one year after the premature loss. (Image by Patricia Nadelman PhD student - CVMT/FO-UFRJ®).

Figure 3. Patient M.C.C., female, 4 years old, premature loss of primary central incisors and lateral incisor (51,61 and 62). Intraoral frontal photograph 6 months after the loss. (Image by Patricia Nadelman PhD student - CVMT/FO-UFRJ®).

Canines

Premature loss of primary canines is usually caused by ectopic eruption of permanent lateral incisors, accelerating the resorption of one or both primary canine roots.[38] Notably, this phenomenon can occur in both mandibular and maxillary arches.[38] Trauma is another reason for premature loss of canines, but with reduced prevalence.[23]

Figure 4. Patient M.F.F., male, 4 years old, unilateral premature loss of primary canine (53). Intraoral frontal photograph 15 days after the loss. (Image by Fernanda Vieira, Master's student - CVMT/FO-UFRJ®).

Concerning the number of canines lost or extracted, unilateral cases (Figure 4) usually present permanent incisor shift toward the affected side, and a resultant midline deviation.[38] It has been suggested that if the loss is bilateral, instability is reduced.[38] When loss occurs in the mandibular arch, it might result in a lingual inclination of the permanent lower incisors, and consequent arch perimeter reduction.[40]

To date, there has been no consistent information on the premature loss of primary anterior teeth in regard to either the types (incisors or canines) or the quantity of primary anterior tooth loss.[38] There are a few studies in the literature that do not provide an adequate quality of evidence, attributed especially to methodological flaws.[7,8,9,14,15,24,25] It is worth mentioning that the majority of studies are reviews, but they should ideally be observational or interventional clinical studies.[18,23,38] To the best of our knowledge, this is the first critical review comprising all the aspects of premature loss of primary anterior teeth, including the etiology, diagnosis, consequences and interventions. The current critical review also presents relevance, insofar as it highlights the need for further studies on this topic.

Consequences of premature loss of anterior teeth

The consequences of premature loss of anterior teeth involve morphological, functional and psychosocial

aspects.[23] Morphological effects include interferences in development and eruption of permanent successors teeth, as well as impairment of arch integrity.[23] Functional impairments comprise alteration of speech evolution, and establishment of non-nutritive habits.[23] Lastly, psychosocial damages may influence a child's aesthetic perceptions and quality of life.[23]

Morphological consequences

Effects of premature loss on development and eruption of successor teeth.

The premature loss of primary anterior teeth may cause damage to permanent successors, because of its strong relation with arch perimeter reduction, leading to impaction and eruption disturbances (delay or anticipation).[4,41,42,43]

In addition, if premature loss is caused by trauma, it can contribute to the development of other sequelae in permanent teeth, including dental hypoplasia and discoloration, crown or root dilacerations, and sequestration of permanent successor tooth germ.[23] The prevalence of impairment to permanent successor development after avulsion of primary teeth has been reported to range between 30% and 85%.[23] The younger the child at the time of injury, the greater the frequency and severity of the damage observed in permanent successors.[44]

Regarding permanent successor eruption, premature loss of primary anterior teeth may accelerate or delay successor tooth eruption, according to Nolla's dental age assessment.[3] If the loss occurs prior to the successor's reaching Nolla's stage 6 (when the crown is entirely formed), it may result in bone or fibrotic tissue formation on top of the tooth germ, in which case additional resistance to eruption is created, ultimately impacting or delaying the eruption of successor teeth.[3,39] However, if the loss occurs after the successor has reached Nolla's stage 6 – in other words between Nolla's stage 7 and 8 – its eruption can be accelerated, since eruption movements had already been initiated before that stage.[3] It is important to highlight that this acceleration may also be related to the amount of bone loss in cases of periapical lesions. In these situations, there is often an accelerated eruption of the successor, even without the permanent tooth's having reached Nolla's stage 6.[45]

A final consideration is that the premature loss of primary incisors may also be associated with the malposition of their permanent successors.[42] This could result from a lack of eruption guidance for permanent teeth, which may lead to ectopic eruption and resultant malocclusion[42].

Problems related to arch integrity

If deciduous arch integrity is compromised, it can reveal problems regarding permanent tooth alignment due to arch perimeter reduction.[4,5] There is a further possibility of antagonist tooth extrusion, adjacent tooth migration and inclination, permanent successor tooth impaction, early or late eruptions, midline deviation, and discrepancy between the space available in the dental arch and the space needed for adequate accommodation of successor teeth.[4,5]

According to McDonald and Avery,[5] premature loss of upper and/or lower primary incisors may lead to anterior space loss, if it occurs prior to the eruption of the primary canines. In addition, certain other factors might also influence space loss, including Baume's deciduous dental arch types, and the presence of non-nutritive habits. There are cases in which primary anterior teeth are in contact with one another before the tooth loss (*i.e.*, Baume type II arch), or in which there is arch-length discrepancy in the anterior region. These represent potential factors for space loss because space adjustments may occur between the teeth after loss of one of the incisors.[5]

Despite this information, most of the existing studies in the literature, presented in a previous systematic review, are limited to covering the issue of maintaining space for premature loss of posterior teeth.[46] Hence, there remain gaps in our knowledge of the spatial consequences of early loss of anterior teeth. Only a few studies were found in the literature evaluating arch perimeter changes in the deciduous arch itself,[13,14,15] and how these changes affect permanent tooth alignment[12,47] after premature loss or extraction of primary incisors and canines.

In one investigation, Clintch and Healy[13] reported no closure of anterior space after the premature extraction of incisors and canines. Conversely, Kohn[41] claimed that the space in the incisor region must be maintained if premature loss occurs prior to the age

of four years, since the crowns of permanent incisor are too high up in the maxilla to successfully maintain the space. Furthermore, Miyamoto, Chung and Yee[12] indicated that the premature loss of one or more primary canines requires more frequent orthodontic treatment to manage permanent dentition.

Lastly, a couple of previous studies[12,13,14,15,47] presented some limitations, such as small sample size and absence of a control group.

Functional consequences

Speech impairment

Regarding phonation, it is known that teeth play an important role during the production of certain speech sounds.[48] Consequently, tooth loss may impair the pronunciation of certain consonants (*e.g.*, 'v', 'f', 'th', 'z', and 's'), since their correct production requires forcing the air stream through an opening in the oral cavity small enough to produce frictional noises.[48] Moreover, anterior maxillary teeth are considered one of the structures responsible for speech development and the articulation of certain sounds.[23] It is also known that anterior teeth appear to be particularly important for the correct production of certain phonemes, mainly 's' and 'z' sounds;[8,24] therefore, premature loss of these teeth may lead to speech problems. Riekman and ElBadrawy evaluated the speech of 14 children, with an average age of 22.7 months, who had their maxillary primary incisors extracted, as a result of nursing bottle caries (early childhood caries),[24] and reported that impairment of young children's speech could occur if they experienced the premature loss or extraction of their four maxillary primary incisors. It is also important to consider that the sequelae of premature tooth loss on speech might vary not only according to chronological criteria, but also to a child's individual speech pattern, since the child may have acquired the ability to pronounce phonemes properly at early stages of development. Nevertheless, some authors suggest that phonation problems in children younger than 5 years old may be considered normal, since the acquisition of all phonemes should be complete by the literacy phase.[35] Therefore, the diagnosis of speech disorders can only be confirmed after 5 years of age, at which time persistent phonation problems should be evaluated and treated as soon as possible.[35]

Additionally, Kalia et al.[49] evaluated speech changes before and after prosthetic rehabilitation with fixed functional space maintainers in children with missing maxillary anterior teeth. Their study observed significant distortions and articulation errors of 'v', 'd', 'dh', 't', 'th', 's', and 'sh' consonants. They also described an improvement in the articulation of these sounds after fixed appliances were inserted in children aged 3 to 6 years, with at least two missing maxillary anterior teeth.

The only systematic review and meta-analysis[10] published on this topic in the literature evaluated the consequences of premature loss of primary anterior teeth on children's speech and arch integrity, compared to children without premature losses. This meta-analysis showed that the premature loss of primary anterior teeth might cause speech distortion. Despite this information, the few studies published in the literature that investigated the consequences of premature loss/extraction of primary anterior teeth have methodological limitations of and low-level evidence-based quality, and are based on outdated literature.

Development of non-nutritive habits

Another consequence of premature primary anterior tooth loss is the development of non-nutritive habits in children who did not present these habits before the loss, and an increase in the frequency of those who did, particularly with a previous history of pacifier use, digital sucking, and tongue thrusting.[4,23] Normally, the establishment of non-nutritive habits is overlooked in relating the sequela of early tooth loss. More commonly, it has been reported to cause atypical swallowing, with tongue thrusting occurring in the unnatural space. Long-term alterations can cause impairment of respiratory ability and delayed nasal breathing, and even induce mouth-breathing development.[50,51]

Tongue thrusting[1,4,16,17] is one of the main non-nutritive habits established as a consequence of tooth loss, and an extremely important issue that must be managed.[51] Additionally, the presence of non-nutritive habits may influence morphological changes, such

as dental arch space loss.[5] The magnitude of the changes resulting from oral habits depends on three factors: frequency, intensity and duration of the habit, described as Graber's Triad.[4]

Psychosocial consequences

There are currently gaps in the literature concerning the impact of early loss of primary anterior teeth on children's quality of life.[23] Several instruments have been developed to assess the oral health-related quality of life, according to each age group,[52] by means of direct and proxy sources of information. Direct instruments comprise patient-reported data, such as the Scale of Oral Health Outcomes for 5-year-old children (SOHO-5).[53] However, it should be borne in mind that the children's responses may be limited, considering that children younger than 5 years old might not be aware of the tooth loss,[54] and are too young to understand how lacking a tooth really affects their oral aesthetics or quality of life.[23]

Since the young age of patients may be a limiting factor for the application of direct questionnaires, authors should develop studies using proxy-reported measures to assess a young patient's quality of life through reports by parents.[55] The approach using proxies, such as the Early Childhood Oral Health Impact Scale (ECOHIS),[56] can provide relevant information on how parents conceive their child's perception of premature loss on quality of life.[56]

Since young children are practical and simplistic in dealing with issues related to their oral health, some concerns are commonly restricted to the parents' perceptions.[23] They imagine that the premature loss of primary anterior teeth may affect the child's appearance, by making the child unattractive.[57,58,59] This could be a limitation of the proxy-reported questionnaires, which would probably express the guardians' understanding of tooth loss rather than the child's perception. The abovementioned constraints may explain the few studies conducted in this age group.[7,8,9] According to Moss and Maccardo,[54] children are not aware of any damage to a primary tooth prior to the age of five or six years old, and would not be aware of early loss of an incisor or a canine if this injury occurred before four years of age.

In stark contrast, a study revealed that preschool-aged children point out characteristics of other kids based on their own appearance.[60] Kapur et al.[61] suggested that younger children, even those younger than three years of age, are aware of their appearance and ask their parents to look for dentists to resolve aesthetic issues resulting from missing teeth. The authors add that parents and caregivers are most likely to be affected by their children's premature tooth loss[23], but there are few data in the literature supporting this finding.

Interventions

There are two conflicting scientific thoughts concerning the management and treatment of premature anterior tooth loss or extractions. The main issue is whether or not to intervene in cases of premature loss or extraction of primary incisors and canines. Those who oppose using space maintainers claim that the space resulting from early loss may or may not diminish over time.[17] In cases where spaces do no diminish, intervention with a space maintainer can be dispensed with, whereas cases of previous negative arch discrepancy require that patients seek orthodontic treatment to recover the space, regardless of arch perimeter reduction due to premature loss.[21,22] Moreover, researchers believe that anterior losses do not compromise the arch perimeter as much as posterior losses do.[18]

Conversely, those who favor the use of space maintainers believe that a prematurely lost space is usually permanently lost, and this may cause deleterious effects on permanent dentition, owing to a reduction in the arch perimeter.[19] In addition, if a primary anterior tooth is lost at a very early age, bone may form from the dental germ, and cause late eruption of the permanent tooth, ultimately also resulting in an arch perimeter reduction.[5]

Considering the number of primary anterior teeth lost or extracted, it has been suggested that if just one or two central incisors are lost early, the use of a space maintainer is not strictly necessary. However, when both central and lateral incisors are lost prematurely, the use of a space maintainer should be considered, because multiple losses could favor the development of deleterious oral habits, in

addition to dental extrusion from lack of contact with the opposing teeth[39] and speech impairment. Regarding the premature loss of primary canines, an appropriate appliance for space maintenance should be considered, since this loss represents a major problem caused by the adjacent tooth's shifting, and potential midline deviation.[39]

Among the space maintainers for the anterior region, a fixed aesthetic space maintainer is preferred[38]. This appliance is a variation of the fixed bilateral space maintainer, and is indicated specifically for replacing missing maxillary incisors. Although this appliance is used primarily to resolve aesthetic issues, it can also help with a child's mastication and phonation.[38] Regarding removable aesthetic appliances, they are less widely used because children who lose anterior teeth early are usually very young, and too immature to use removable appliances, owing to the risk of deglutition, and the possibility that the child will not comply with its wear and care instructions[5]. Moreover, appliances that are indicated to best address mandibular canine losses are normally lower-lingual holding arches. These space maintainers are designed to include soldered hooks to resist or inhibit the distal shifting of incisors.[38]

Additionally, there is a classic recommendation published in the literature[62] regarding the need for maintaining space in the anterior region. If primary maxillary and mandibular incisors are lost after the eruption of canines, space maintenance is not necessary because the lower arch is 'coupled to' or 'inside' the upper arch, and the space would likely reopen when the permanent teeth erupts.[62] On the other hand, if the loss of a primary incisor occurs prior to eruption of the canines, space maintenance is needed because the primary lateral incisors could shift distally, resulting in space loss and occupation of the space of the primary canines. Finally, if a lower or upper primary canine is lost, the space must also be maintained to prevent midline deviation.

As a final consideration in this section, it is important to point out that the use of fixed maintainers requires some special care, including biofilm control with adequate oral hygiene and controlled diet, since the retention of bulky food waste in oral devices may increase the risk of caries progression.[36] Hence, a fixed space maintainer is contraindicated in patients with a high risk of caries and deficient biofilm control.[36] Furthermore, a periodic follow-up for professional prophylaxis is recommended.[36]

Conclusion

The absence of robust scientific data on the implications and possible interventions for premature loss of primary incisors and canines has led dental professionals to depend largely on clinical experiences in deciding the clinical course of treatment. However, clinical decisions should be made based on scientific evidence, whenever possible.

Currently, the scientific literature shows that the etiology of the premature loss of primary anterior teeth may be associated with extraction resulting from advanced dental caries; trauma related to avulsion or extraction based on poor prognosis, late complications, or early exfoliation following primary tooth accelerated root reabsorption; premature root resorption; and neonatal tooth extraction. Premature tooth loss diagnosis can be performed based on the patient's dental history, and clinical and radiographic examinations.

Data also shows that the implications resulting from premature anterior tooth loss may or may not interfere in the development and eruption of permanent successor teeth; influence arch integrity; alter speech development; promote the establishment of non-nutritive habits; and affect the child's aesthetic perceptions and quality of life.

The possible effects of premature loss of primary anterior teeth can be minimized through interventions, such as fixed aesthetic space maintainers, which can serve as an alternative for replacing missing anterior teeth. Although these appliances are used primarily for aesthetic purposes, they can also improve a child's mastication and phonation. Another appliance is the lower-lingual holding arch, commonly used to address mandibular canine losses. It is important to highlight that special care must be observed, including biofilm control with adequate oral hygiene and controlled diet.

Despite the abovementioned points, the authors of the present review would like to highlight that further controlled observational studies with higher methodological quality are needed to report issues such as the sequelae of premature loss of primary incisors and canines to the dental arch perimeter, speech pattern, oral function, aesthetics and quality of life. Additionally, interventional studies will likely assist in addressing this challenge by clearly elucidating the actual need for space-maintainer interventions made to provide both safe clinical practices and adequate management of the premature loss of primary anterior teeth.

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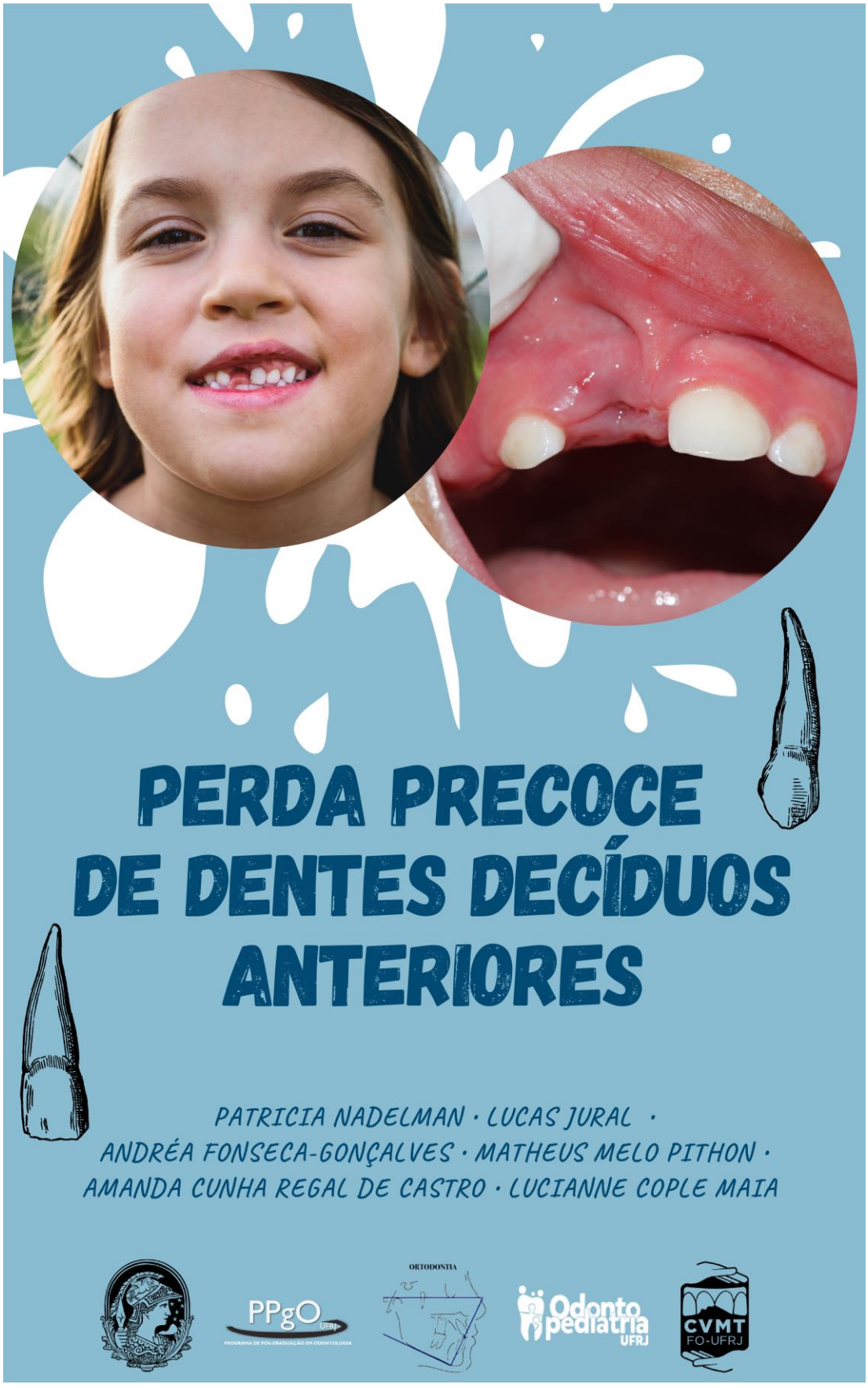
4.3 Produto técnico – e-book: Perda precoce de dentes decíduos anteriores.

O livro digital intitulado “Perda precoce de dentes decíduos anteriores” foi submetido e arquivado na coleção “Ciências da Saúde” do Repositório Institucional da UFRJ (PANTHEON) que visa reunir, preservar e disseminar a produção acadêmica da UFRJ em todas as áreas do conhecimento, em consonância com o movimento de livre acesso à informação científica.


PERDA PRECOCE
DE DENTES DECÍDUOS
ANTERIORES
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Sumário

PERDA PRECOCE DE DENTES DECÍDUOS ANTERIORES

Apresentação

A perda precoce de dentes decíduos anteriores é um tema pouco explorado na literatura científica. Devido à ausência de evidências robustas sobre as consequências e possíveis intervenções para perda precoce de dentes decíduos, profissionais da Odontologia apoiam-se em experiências clínicas para decisão da melhor conduta a ser considerada, o que não deve ser uma rotina, pois a tomada de decisão clínica precisa estar embasada, considerando a melhor evidência científica disponível.

Assim, o presente livro é uma revisão de dados com base em revisões de literatura, sistemáticas, metanálises e estudos clínicos.Visa orientar os alunos de Odontologia, cirurgiões-dentistas recém-formados e clínicos quanto ao diagnóstico, decisão terapêutica e tratamento, propriamente dito, da perda precoce de dentes decíduos anteriores.

DENTIÇÃO DECÍDUA

Importância da dentição decídua

A **dentição decídua** apresenta **importância funcional, psicossocial e morfológica** para a **criança**, auxiliando no crescimento e desenvolvimento adequado dos **ossos e musculatura facial,** na **mastigação,** na **fonação** e na **estética** (Brothwell, 1997).

Além disso, a **manutenção da integridade dos arcos decíduos** exerce influência no **desenvolvimento da dentição permanente, mantendo o perímetro dos arcos e preservando espaço para erupção** dos dentes sucessores permanentes (Thurow, 1977).

Figura 1: Fotografia clínica intrabucal ilustrando a substituição de dentes decíduos por seus respectivos sucessores permanentes.

Importância da dentição decídua

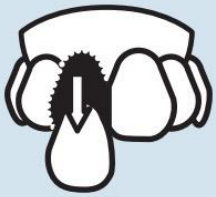
Figura 2: Fotografia clínica intrabucal indicando paciente durante a fase de dentição decídua em desenvolvimento normal da oclusão.

A **supervisão do desenvolvimento das dentições** é um componente fundamental do exame de toda criança. Assim, o **diagnóstico e tratamento precoce de danos na dentição decídua produz resultados benéficos, tanto para a fase mista da dentição quanto para a dentição permanente** (McDonald, Avery & Dean, 2011).

A fim de manter os **dentes decíduos saudáveis**, responsável/paciente devem ser orientados, não somente quanto às práticas de **prevenção da cárie dentária** como controle do biofilme e dieta adequada, mas também quanto à **prevenção do traumatismo dentário** (Khan, 2019; AAPD, 2020a, 2020b).

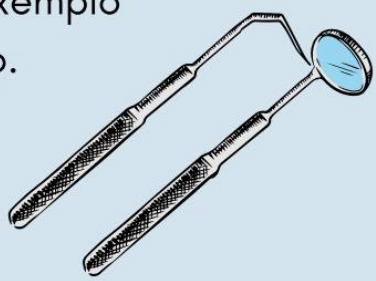
PERDA PRECOCE DE DENTES DECÍDUOS

PERDA PRECOCE DE DENTES DECÍDUOS



Se a integridade do arco for comprometida pela **perda precoce de dentes decíduos**, é possível resultar em problemas que **afetam a erupção dos dentes permanentes**. Dentre esses: extrusão de dentes antagonistas, migração e/ou inclinação de dentes adjacentes para o espaço da perda, giroversão de dentes.

Quando há **perda precoce de dentes decíduos**, pode se fazer necessária a adoção de medidas terapêuticas, como a **manutenção ou recuperação do espaço**. Pode haver ainda necessidade de tratamento interdisciplinar, como por exemplo com um fonoaudiólogo.



(Holan & Needleman, 2014)

O QUE É A PERDA PRECOCE DE DENTES DECÍDUOS?

É a perda de um ou mais dentes decíduos um ano (ou mais) antes da sua esfoliação normal, enquanto o sucessor permanente ainda não se encontra no estágio 6 de Nolla (Santos et al., 2013).

> O estágio 6 de Nolla é caraterizado pela formação completa da coroa dentária e 2/3 de desenvolvimento da raiz (ou radicular), evidenciado pela radiografia periapical (Nolla, 1960). Como o dente sucessor intra-ósseo ainda não se encontra em estágio adequado de erupção, este não pode ser palpado ao exame clínico.

Figura 3: Fotografia clínica intrabucal e radiografia oclusal de paciente apresentando perda precoce do dente 61.

COMO PODEMOS CLASSIFICAR A PERDA PRECOCE DE UMA FORMA GERAL?

Quanto à localização:

Anterior

Figura 4: Fotografia clínica intrabucal indicando perda precoce do dente 61.

Posterior

Figura 5: Fotografia clínica intrabucal ilustrando perda precoce dos dentes 84 e 85.

Quanto ao número:

Unitária

Figura 6: Fotografia clínica intrabucal indicando perda precoce unitária do dente 51.

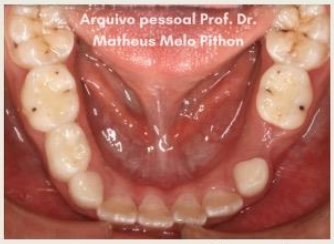


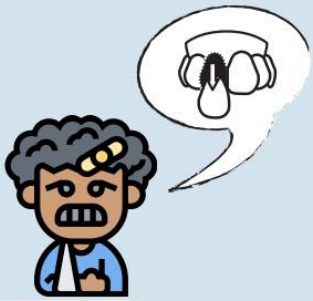
Figura 7: Fotografia clínica intrabucal indicando perda precoce unitária do dente 74.

Múltipla

Figura 8: Fotografia clínica intrabucal indicando perda precoce anterior múltipla dos dentes 51, 52, 61 e 62.

Figura 9: Fotografia clínica intrabucal indicando perda precoce posterior múltipla dos dentes 74, 75, 84 e 85.

QUAL A ETIOLOGIA DA PERDA PRECOCE ANTERIOR?



1) Traumatismos dentários

A **avulsão** de dentes decíduos anteriores ocorre principalmente em **crianças de 2 a 4 anos**. A perda dentária pode resultar da **extração por mau prognóstico, complicações tardias, intrusão, fratura radicular e diversos tipos de lesões por luxação** (Holan & Needleman, 2014).

2) Cárie dentária

A **cárie na primeira infância** é definida como a presença de uma ou mais superfícies cariadas, perdidas ou restauradas em qualquer dente decíduo de uma criança com menos de seis anos de idade (Pitts et al., 2019). Essa perda **perda precoce do dente** ocorre quando a **lesão está avançada** e o **tratamento endodôntico não é recomendado** devido à reabsorção radicular acelerada ou impossibilidade de tratamento, sendo indicada a **exodontia** (Cummins, 2013).

QUAL A ETIOLOGIA DA PERDA PRECOCE ANTERIOR?

3) Exodontia de dente natal/neonatal

A **exodontia** desses dentes é **indicada** quando apresentam **ausência de formação de raízes e implantação dentária inadequada**, levando à **mobilidade** excessiva que poderia resultar em deslocamento dentário com **possibilidade de deglutição ou aspiração do dente** (Kana et al., 2013).

4) Reabsorção radicular precoce

A **perda prematura** de dentes decíduos anteriores por **reabsorção radicular precoce**, ocorre principalmente em **casos de discrepâncias negativas entre tamanho dentário e base óssea alveolar** (Law, 2013). Por exemplo: quando um incisivo central permanente erupciona causando a reabsorção dos incisivos central e lateral decíduos simultaneamente.

PERDA PRECOCE DE INCISIVOS DECÍDUOS

Figura 10: Fotografia clínica intrabucal indicando perda precoce do dente 61.

A **perda precoce de incisivos decíduos superiores** ocorre em decorrência de traumatismo dentário, cárie dentária e reabsorção radicular precoce (Holan & Needleman, 2014).

Figura 11: Fotografia clínica intrabucal indicando perda precoce do dente 71.

A **perda precoce de incisivos decíduos inferiores** decorre, principalmente, da erupção ectópica dos incisivos permanentes, além de traumatismo dentário, cárie e exodontia de dente natal/neonatal (White, 1981).

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Figura 12: A- Fotografia clínica intrabucal e B- Radiografia periapical evidenciando atraso na erupção do dente 21 em decorrência de trauma no dente 61.

Atraso ou aceleração da época de erupção do sucessor permanente:

- Se no momento da perda do dente decíduo, o dente permanente sucessor apresentar-se **antes do estágio 6 de Nolla**, ocorre **atraso de sua erupção**;
- Se no momento da perda do dente decíduo, o dente permanente sucessor apresentar-se **após o estágio 6 de Nolla**, ocorre **aceleração de sua erupção**.

Por quê?

A partir do **estágio 6 de Nolla**, o germe dentário **inicia sua trajetória de erupção** em direção oclusal (Nolla, 1960).

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Figura 13: Fotografia clínica intrabucal indicando paciente com perda precoce do dente 61 e fechamento parcial do espaço da perda.

Desenvolvimento de maloclusões

* A perda de incisivos decíduos pode resultar em **fechamento de espaço,** caso ocorra **antes** que os **dentes permanentes se desenvolvam** o suficiente para manter as dimensões do arco dentário (Moyers, 1991).

* Na maioria dos casos, **não há necessidade de instalação de mantenedores de espaço** para incisivos decíduos perdidos **após os 4 anos** de idade (Law, 2013).

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Danos estéticos, psicológicos e na qualidade de vida

Existem **duas vertentes** sobre a influência da perda precoce de dentes anteriores na qualidade de vida de bebês e crianças.

Por um lado, Kapur et al. (2005) sugeriram que, **crianças em idade pré-escolar têm consciência de sua aparência e solicitam aos pais que procurem o dentista por motivos estéticos decorrentes da perda dentária.**

Figura 14 A, B e C: Fotografias clínicas extrabucais ilustrando reações negativas de criança com perda precoce do dente 51.

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Danos estéticos, psicológicos e na qualidade de vida

Por outro lado, Moss & Macardo (1985) acreditam que **crianças menores que cinco ou seis anos de idade não têm consciência ou discernimento dos danos da perda dentária**.
Além disso, os **pais e cuidadores são provavelmente os mais afetados pela perda dentária prematura de suas crianças** (Styczynski & Langlois, 1977).
Entretanto ainda existem poucos dados na literatura que apoiam esse achado.

Figura 15: Fotografia clínica extrabucal ilustrando reação favorável de criança, independente da perda precoce do dente 61.

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Figura 16: Fotografia clínica intrabucal indicando interposição lingual na região da perda dentária do dente 51 durante a deglutição.

Potencial desenvolvimento de alterações das funções orais como a deglutição com interposição lingual e fonação atípica

Os **dentes anteriores** funcionam como **barreira para a língua durante a deglutição**, por isso, a ausência dos mesmos causa o estabelecimento de deglutição atípica devido à interposição lingual na região da perda dentária durante a deglutição (Proffit & Mason, 1975).

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Estabelecimento de hábitos bucais deletérios

A **perda precoce** de dentes decíduos anteriores pode **iniciar, cessar ou prolongar hábitos bucais deletérios**, como a sucção de chupeta e/ou dedo e a interposição lingual (Holan & Needleman, 2014). Porém, ainda há escassez de evidência científica indicando essa associação. Há mais estudos (Hawes, 1966; Wright & Friedman, 1985) relatando a relação positiva entre **perda prematura de incisivos decíduos e interposição lingual**.

Figura 17: Fotografia clínica intrabucal apresentando paciente com mordida aberta anterior em decorrência da sucção digital iniciada após perda precoce do dente 51.

CONSEQUÊNCIAS DA PERDA PRECOCE DE INCISIVOS DECÍDUOS

Alteração na fonação

Dentes anteriores desempenham papel importante na fala durante a produção de sons como 'd', 'f', 's', 'v' e 'z' quando tocam na língua ou no lábio (Kantner & West, 1960), por isso, a **perda deles pode causar distúrbios na fonação** (Lamberghini et al., 2012).

A única metanálise (Nadelman et al., 2020) publicada sobre o tema mostrou que a perda **precoce de dentes decíduos anteriores** pode causar **distorção da fala**, principalmente, na pronúncia de 's' e 'z'.

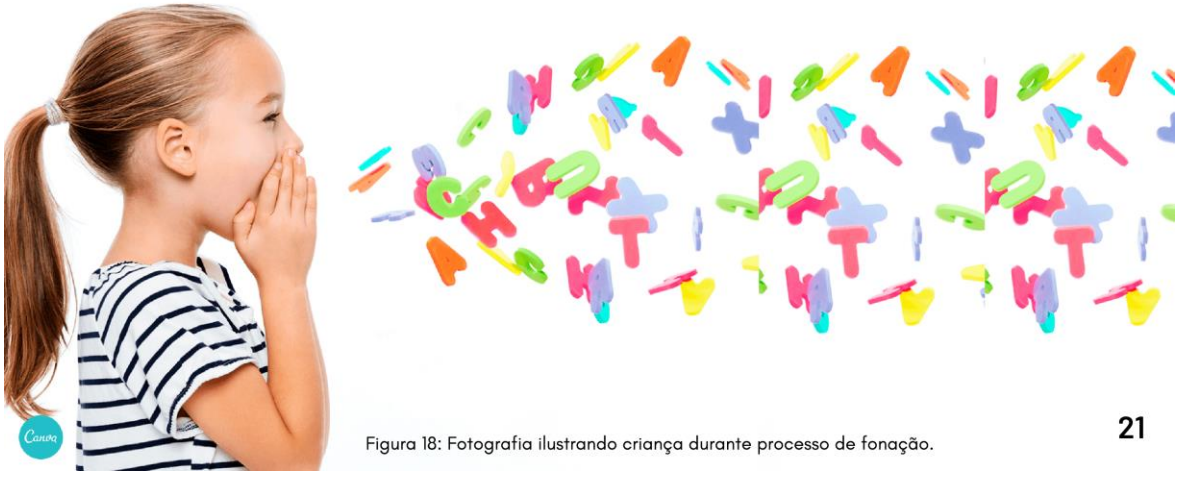


Figura 18: Fotografia ilustrando criança durante processo de fonação.

PRECISAMOS TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

Acredita-se que a perda precoce de incisivos decíduos, de modo geral, não resulta na perda de espaço no perímetro do arco, se a perda do incisivo ocorrer após a erupção dos caninos decíduos (White, 1981).

Figura 19: Fotografia clínica intrabucal indicando perda precoce do dente 61.

A perda de **um incisivo decíduo superior** pode resultar em ligeiro desvio de linha média, mas **normalmente não há indicação de tratamento**.

Figura 20: Fotografia clínica intrabucal indicando perda precoce dos dentes 51 e 61.

A perda de **dois incisivos decíduos superiores** normalmente não resulta na perda significativa do perímetro do arco e, por isso, também **não há indicação de tratamento**.

Figura 21: Fotografia clínica intrabucal indicando perda precoce dos dentes 51, 52, 61 e 62.

A perda de **três ou quatro incisivos decíduos superiores** pode causar a instalação de hábitos deletérios; influência negativa na fonação, deglutição e mastigação, por isso, o **tratamento é indicado**.

Figura 22: Fotografia clínica intrabucal indicando perda precoce do dente 71.

Na perda de **incisivos inferiores**, deve-se monitorar o desenvolvimento da região, mas em geral, **nenhum tratamento é indicado**.

FATORES QUE INFLUENCIAM A PERDA DE ESPAÇO NA REGIÃO ANTERIOR

Alguns fatores podem **influenciar na redução de espaço anterior** e, por isso, sugerem a necessidade de manutenção de espaço (McDonald, Avery & Dean, 2011):

- Perda precoce de incisivos decíduos anterior à erupção dos caninos decíduos;

Figura 23: Fotografia clínica intrabucal de paciente com perda precoce do dente 61 anterior à erupção dos caninos decíduos.

- Arco decíduo tipo II de Baume, caracterizado pela ausência de espaços interdentais, no qual os dentes se apresentam em íntimo contato;

Figura 24: Fotografia clínica intrabucal de paciente com perda precoce do dente 51 em paciente com arco tipo II de Baume.

- Evidência de inadequação do comprimento do arco na região anterior.

Figura 25: Fotografia clínica intrabucal de paciente com perda precoce do dente 51 em paciente com mordida aberta anterior e falta de espaço nos arcos dentários.

PRECISAMOS TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

O uso de mantenedores de espaço na região anterior ainda é controverso. Existem duas vertentes distintas:

1. A vertente oposta (Linder-Aronson, 1960; Lundström, 1955) ao uso de mantenedores de espaço na região anterior acredita que os espaços da perda precoce podem ser perdidos ou não.

- Nos casos em que os **espaços não são perdidos**, a instalação de um **mantenedor de espaço seria dispensada**.

- Nos casos de pacientes com **discrepância negativa de arcos** - que geralmente apresentam apinhamento -, o **tratamento ortodôntico é indicado, independentemente da redução do perímetro do arco após perdas precoces, por isso, não haveria necessidade de manutenção do espaço**.

- Além disso, imagina-se que **muitos espaços perdidos sejam recuperados quando o sucessor permanente entra em trajeto de erupção.**

PRECISAMOS TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

Por outro lado, aqueles que defendem o uso de mantenedores de espaço, acreditam que:

- A **perda precoce** geralmente causa **redução do perímetro do arco**, prejudicando a dentição permanente (Kopel, 1950; Kronfeld, 1953).

- Se o **dente decíduo anterior for perdido** em uma **idade muito precoce**, pode ocorrer **erupção tardia do dente permanente sucessor** (McDonald, Avery & Dean, 2011).

PRECISAMOS TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

Devido à escassez de estudos e às inconsistências metodológicas entre os poucos estudos publicados na literatura, não há uma resposta definitiva sobre a necessidade de tratamento.

Por isso, é importante que cada caso seja avaliado, individualmente, quanto à necessidade de tratamento.

O QUE DEVEMOS LEVAR EM CONSIDERAÇÃO ANTES DE TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

Alguns parâmetros devem ser avaliados para a tomada de decisão:

- Perda de espaço na arcada dentária;
- Interposição lingual;
- Alteração da fonação;
- Alteração na deglutição;
- Dificuldade de mastigação/corte dos alimentos;
- Queixa estética;
- Impacto negativo na qualidade de vida.

COMO TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

1 Mantenedor estético fixo:

Aparelho com dentes de estoque (artificiais) fixos a um fio de aço rígido e bandas nos molares decíduos. Além de manter o espaço, o aparelho impede a interposição lingual na região e restabelece a fonação, mastigação e deglutição (Law, 2013).

Figura 26: Fotografia clínica intrabucal de mantenedor estético fixo com reposição dos dentes 51, 61 e 62.

Indicações:

- Restabelecimento de função e estética;
- Prevenção de migração e extrusão de dentes adjacentes e antagonistas, respectivamente.

Contraindicação:

- Deficiência de higiene bucal.

Vantagens:

- Vida útil prolongada;
- Independe da cooperação do paciente para o uso.

Desvantagem:

- Maior tempo de cadeira.

COMO TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

2 Mantenedor estético removível:

Podem ser na forma de próteses parciais em resina acrílica com dentes de estoque, retidos nos dentes adjacentes por grampos ou, ainda, na forma de placa palatina/lingual com dentes de estoque (Law, 2013).

Figura 27: Fotografia clínica intrabucal de mantenedor estético removível com reposição dos dentes 51, 52, 61 e 62 (Cassol et al., 2019).

Indicações:

- Reestabelecimento de função e estética;
- Prevenção de migração e extrusão de dentes adjacentes e antagonistas, respectivamente.

Contraindicações:

- Pacientes muito jovens;
- Pacientes pouco colaboradores.

Vantagens:

- Fácil higienização;
- Funcional.

Desvantagens:

- Menor vida útil;
- Depende da colaboração do paciente para o uso;
- Facilidade de perda, deformações e fraturas.

COMO TRATAR A PERDA PRECOCE DE INCISIVOS DECÍDUOS?

3 Acompanhamento sem mantenedor estético:

Devemos avaliar o paciente periodicamente a fim de detectar problemas decorrentes da perda dentária. Na ausência de danos, podemos optar pelo acompanhamento da perda precoce sem instalação de mantenedor de espaço. Na presença de danos, devemos definir qual tratamento realizar (Day et al., 2020).

Figura 28: Fotografia clínica intrabucal apresentando paciente com perda precoce do dente 51 sem manutenção de espaço.

Indicação:

- Ausência de consequências morfológicas (ex: perda de espaço); funcionais (ex: alteração da fonação, deglutição e mastigação); ou psicossociais (ex: prejuízo à qualidade de vida e estética).

Vantagens:

- Baixo custo;
- Não depende da cooperação do paciente.

Desvantagem:

- Não restabelece o componente estético da perda dentária.

PERDA PRECOCE DE CANINOS DECÍDUOS

Figura 29: Fotografia clínica intrabucal apresentando perda precoce do dente 53.

A **perda de caninos decíduos** ocorre com maior frequência pela **erupção ectópica dos incisivos laterais permanentes**, mas também pode ocorrer em decorrência de trauma (Law, 2013).

Quando a **perda do canino decíduo** ocorre por **reabsorção radicular precoce** em decorrência da **erupção ectópica do incisivo lateral**, é um **indicativo de discrepância entre o tamanho dos dentes e espaço disponível no arco dentário** (Kau et al., 2004).

PERDA PRECOCE DE CANINOS DECÍDUOS

Figura 30: Fotografia clínica intrabucal ilustrando paciente com perda precoce do dente 63 em decorrência de avulsão.

As possíveis consequências da perda precoce de caninos decíduos são:

- Desvio de linha média em direção ao lado da perda;
- Aumento da sobremordida;
- Alteração do eixo de erupção de caninos permanentes e pré-molares;
- Perda de perímetro do arco dentário;
- Inclinação e/ou migração dos dentes adjacentes;
- Extrusão de dentes antagonistas.

PRECISAMOS TRATAR A PERDA PRECOCE DE CANINOS DECÍDUOS?

A perda precoce de caninos decíduos pode resultar em movimentação dentária e desvio de linha média, por isso, a **necessidade de tratamento** pode ser maior em relação à perda de incisivos (McDonald, Avery & Dean, 2011).

Figura 31: Fotografia clínica intrabucal indicando perda precoce do dente 73.

Perda unilateral de canino inferior decíduo pode ser acompanhada de **desvio da linha média** em direção ao lado da perda, **colapso lingual** e possível **aumento da sobremordida**. Nesses casos, a **intervenção torna-se necessária.**

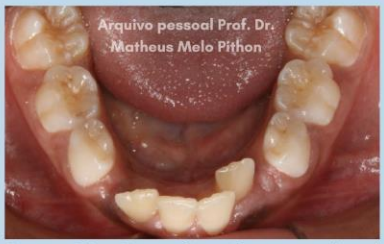


Figura 32: Fotografia clínica intrabucal indicando perda precoce dos dentes 73 e 83.

Perda bilateral de caninos inferiores decíduos pode resultar em **inclinação lingual e migração distal dos incisivos permanentes, aumento da sobremordida e sobressaliência e perda de perímetro do arco**. A i**ntervenção torna-se também necessária**.

Figura 33: Fotografia clínica intrabucal indicando perda precoce do dente 53.

Perda de caninos superiores decíduos pode gerar **perda de espaço anterior**, resultando em **apinhamento e impactação dos caninos permanentes**. Essa perda é indicativo de **antecipação de tratamento ortodôntico**.

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COMO TRATAR A PERDA PRECOCE DE CANINOS DECÍDUOS?

1 Exodontia do canino decíduo contralateral

Se o **canino decíduo for perdido durante a erupção do incisivo lateral** na cavidade bucal, a **exodontia do canino decíduo contralateral** pode ser feita para **preservar a simetria do arco**. É possível melhorar o alinhamento dos incisivos e a integridade da linha média (McDonald, Avery & Dean, 2011).

2 Arco lingual

Mantenedor de espaço fixo indicado para **perda precoce de caninos decíduos inferiores**, a fim de **controlar o posicionamento do incisivos laterais permanentes e impedir a migração dentária para a região de erupção dos caninos permanentes** (Law, 2013).

Figura 34: Fotografia clínica intrabucal apresentando paciente com arco lingual para tratamento de perda precoce do dente 73 e 83.

COMO TRATAR A PERDA PRECOCE DE CANINOS DECÍDUOS?

3 Acompanhamento sem manutenção de espaço

Figura 35: Fotografia clínica intrabucal indicando paciente com precoce do dente 53 sem manutenção de espaço.

O acompanhamento do paciente sem a manutenção de espaço pode ser realizado a fim de **acompanhar o surgimento de consequências negativas no arco dentário**. Caso identificadas, tais consequências podem ser tratadas por meio de tratamento ortodôntico corretivo na fase de dentição permanente (Day et al., 2020).

4 Antecipação do tratamento ortodôntico

Se os **caninos decíduos superiores forem perdidos**, pode ocorrer um **deslocamento de erupção dos incisivos laterais permanentes para a distal, alinhamento anterior superior atípico**, resultando em apinhamento e **impactação do canino permanente superior** (Proffit, Fields & Sarver, 2012). Essa perda precoce indica a **necessidade de intervenção ortodôntica**.

CONSIDERAÇÕES FINAIS

CONSIDERAÇÕES FINAIS

A perda precoce de dentes decíduos anteriores pode afetar:

- Estética e qualidade de vida;
- Evolução da fonação;
- Mastigação e deglutição;
- Desenvolvimento e erupção do sucessor permanente, tais como: impactação de dentes permanentes sucessores e erupções precoces ou tardias;
- Integridade do arco: redução do perímetro, extrusão de dentes antagonistas, migração e/ou inclinação de dentes adjacentes;
- Desenvolvimento de hábitos não-nutritivos.

CONSIDERAÇÕES FINAIS

Evidências sobre a perda precoce de dentes decíduos anteriores ainda são insuficientes.

As **evidências** sobre a perda de espaço na região anterior do arco dentário ainda são **escassas**, havendo lacunas no conhecimento a respeito da **quantidade de espaço perdido**, assim como sobre possíveis **consequências** dentárias e esqueléticas relacionadas a essa condição.

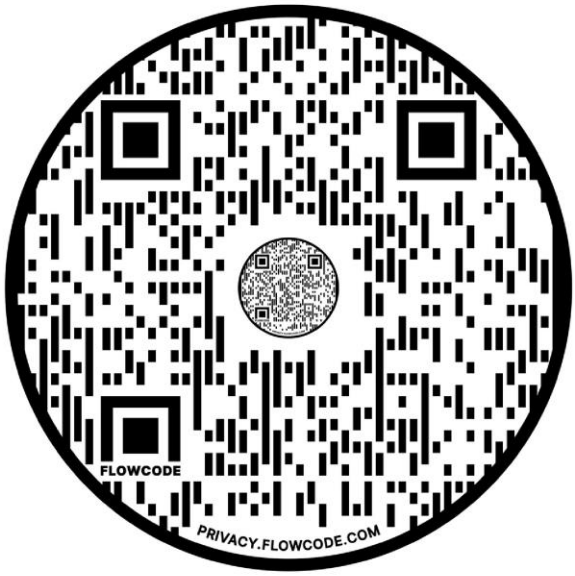
CONSIDERAÇÕES FINAIS

A conduta terapêutica deve ser avaliada individualmente para cada caso. Algumas questões podem ajudar na tomada de decisão:

- Qual tipo de dente perdido?
- Quantos dentes foram perdidos?
- Qual o estágio de erupção dentária se encontra o paciente?
- Paciente possui ou desenvolveu algum hábito deletério após a perda?
- Paciente apresenta alguma maloclusão?
- A perda precoce está influenciando negativamente nas funções como fonação, mastigação, deglutição e respiração?
- Como é o comportamento do paciente?

REFERÊNCIAS

Aponte a câmera do seu celular para o QR code para visualizar as referências



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4.4 Artigo 3: Comparison of three instruments (analogic, analogic with digital display, and digital) for dental linear measurements on plaster and digitalized models of infants and children: an agreement and reproducibility study.

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ABSTRACT

Introduction: The aim of the study was to evaluate the reproducibility and agreement of dental linear measurements made directly on plaster models with a compass, and a digital caliper, compared to digital measurements made through software on the same plaster models after digitalization. **Methods:** 40 plaster models from 20 infants and children aged between 1 and 5 years old, of both sex, with complete or incomplete primary dentition, with or without premature loss of primary anterior teeth were selected. The models were scanned using the Optical 3D scanner. Two trained and calibrated operators performed dental linear measurements with a compass and a digital caliper directly on the plaster models and with the Autodesk Meshmixer software (version 3.5.474) on the digital models. Six measurements were evaluated: missing tooth space (if any), arch perimeter, arch length, arch width, intercanine length and intercanine width. Data were tabulated and statistical analysis was performed using the Jamovi program (version 2.2). Inter-rater reproducibility was calculated using the intraclass correlation coefficient (ICC) and agreement between instruments was analyzed using the Bland-Altman test. **Results:** Inter-rater ICC was considered excellent with consistency values ranging from 0.93 to 1.00. Agreement between the instruments was good, with the mean difference between them ranging from 0.034mm (-1.077; 1.145) to -1.002mm (-2.632; 0.627). **Conclusion:** Dental linear measurements performed in digital models obtained by scanning plaster model achieve excellent reproducibility and good agreement compared to compass and to digital caliper. All measurement instruments should be safely used in dental clinical practice.

Key-words: Dental Model, Dental Impression Technique, Digital Technologies, Deciduous Teeth.

INTRODUCTION AND LITERATURE REVIEW

Managing the developing dentition and occlusion in Pediatric Dentistry through periodical dental occlusion examination is important to verify possible abnormalities in tooth development and growth pattern, either for individuals with premature loss of primary teeth or for those without losses[1]. Complementary exams may be necessary to complete the diagnosis verified during the clinical exam and among them, the analysis of study plaster models may be highlighted[2].

Acquisition of plaster models from dental arches impression has been considered the gold standard and the most used technique of dental arch reproduction[3]. It captures morphological conditions of patients' occlusion in a specific time; complementing the diagnoses and establishing treatment plan; and also enabling an analysis of clinical cases evolution[4]. Besides that, the possibility of digitalizing plaster models, or even directly scanning dental arches, has become a common resource in dental clinic routine[5].

Regardless of the type of study model – plaster or digital –, dimensional changes in arches are evaluated through dental linear measurements related to dental arches development[6]. Traditionally, these measurements were performed using a compass or a brass wire. Later, digital caliper was introduced and currently computer software and digital models are the latest tools used[7].

In order to assist pediatric dentists in deciding the best measurement instrument for dental clinic, a comparison between all of them, specifically for dental linear measurements in primary arches, becomes necessary. Therefore, the aim of the present study was to evaluate reproducibility and agreement of dental linear measurements performed on digital models through software (digital instrument)

compared to measurements made on plaster models both with compass with pointer on both sides (analogic instrument) and digital caliper (analogic instrument with digital display) of the same pediatric patients with or without premature loss of primary anterior teeth. The null hypothesis was that there was no differences between dental linear measurements obtained directly on plaster models with compass, and digital caliper, compared to digital measurements made through software on the same plaster models after digitalization.

METHODS

Study design

The present study is part of a prospective cohort study. Research Ethics Committee approved the study protocol (approval number: 02502818.7.0000.5257, report number: 5.621.927) and an Informed Consent Form was provided to all of tutors allowing participation of infants and children in the study.

This is a study in which primary dentition arches of infants and children were measured to assess reproducibility and agreement of dental linear measurements made directly on plaster models with a compass, and a digital caliper, compared to digital measurements made through software on the same plaster models after digitalization in 3D optical scanner.

Participants

Eligible participants who sought care at the Department of Pediatric Dentistry and Orthodontics of School of Dentistry from Universidade Federal do Rio de Janeiro composed this convenience sample. Recruitment period took place between April 2019 and March 2020.

Sample consisted of infants and children with primary dentition (complete or incomplete), from one to five years old, including both sex, that had premature lost or extraction of primary incisor(s) or canine(s) due to trauma and those without teeth losses.

Exclusion criteria were: patients with special needs; premature loss or extraction of posterior teeth; teeth with cavitated caries lesions and/or restoration; non-nutritive habits; patients with orthodontic or orthopedic appliances; not meeting any of the inclusion criteria; or when the guardian refused to participate of the study.

Test methods

Initially, infants and children's upper and lower arches impressions were taken with alginate Orthoprint Tipo I (Zhermack, Badia Polesine, Italy) in standard perforated plastic (Maquira, Maringá, Paraná, Brazil and Morelli, Sorocaba, São Paulo, Brazil) or aluminum trays (Tecnodent, Indaiatuba, São Paulo, Brazil). Study models were created with special orthodontic plaster (Asfer Indústria Química Ltda, São Caetano do Sul, São Paulo, Brazil) in proportion recommended by the manufacturer, prepared and cut according to proposals from the literature (Camargo and Mucha, 1999).

The plaster models were blindly and individually scanned using the optical 3D scanner (Open Technologies, Rezzato, Lombardy, Italy). Models scanning sequence consisted of scanning the upper model, then the lower model and, lastly, the occluded models in order to obtain inter-arches relation, as well as sagittal, vertical and cross-section adjustment of intercuspation.

Six dental linear measurements concerning dental arch development were considered[8]: (1) missing tooth space (if any), (2) arch perimeter, (3) arch width, (4) arch length, (5) intercanine width and (6) intercanine length (Table 1).

Two trained and calibrated operators (ICC ranging from 0.93 to 1.00) (P.N. and E.O.A.V.) performed the dental linear measurements, directly and digitally, in a blinded and independent way. Direct measurements were performed with one compass (Ice, São Paulo, Brazil) (Figure 1A) and one digital caliper (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japan) (Figure 1B). Measurements from the compass were confirmed with the same plastic ruler (Acrimet®, São Bernardo do Campo, São Paulo, Brazil). Digital measurements were made using the Autodesk Meshmixer software[9] (version 3.5.474, California, United States) (Figure 1C).

Samples were not measured with both instruments sequentially to avoid that one-instrument measurements influenced the others. All data were tabulated in individual tables for each operator.

Statistical analysis

Statistical analysis was performed using the Jamovi program, version 2.2 (Sydney, Australia). Intraclass correlation coefficient (ICC) was applied to calculate inter-rater reproducibility, evaluating reproducibility of measurements among the examiners in each model type. Bland-Altman test was used to assess agreement of measurements' comparison in plaster models and digital models between the two examiners. Mean difference between the instruments and the limits of agreement were used to explain data comparisons.

RESULTS

Participants

Forty plaster models including maxillary and mandibular casts from 20 patients, aged between 1 year and 5 years old, of both sex (12 girls and 8 boys), were measured. Among these 20 patients, 11 showed premature loss of primary anterior teeth and 9 had no premature losses.

Test results

Reproducibility among the operators revealed an excellent inter-rater ICC either for plaster models measurements with compass and digital caliper or for digital models measurements with software showing consistency values ranging from 0.93 to 1.00 (Table 2). The lowest consistency value was from the intercanine length of lower models measured with digital caliper. The highest consistency value resulted from digital measurements of intercanine width of upper models made with software.

Agreement between the instruments was good. Mean difference between digital caliper and software range from -0,048mm (-0.455; 0.358) (Figure 2) in “tooth loss space” measurement to -1.002mm (-2.632; 0.627) (Figure 3) in “arch perimeter” measurement. Mean difference between compass and software ranged from 0.034mm (-1.077; 1.145) (Figure 4) in “arch width” measurement to -0.633 (-2.501; 1.235) (Figure 5) in “arch perimeter” measurement (Table 3).

DISCUSSION

Management of the developing dentition and occlusion is an important component of pediatric dentistry routine[9]. Guidance of the eruption and the development of primary dentition contribute for the early diagnosis of occlusion

complications during childhood[10]. It assists not only the prevention and treatment of malocclusions, but also support the normal growth of dental arches, jaws and face[11].

During occlusion supervision, deviations in dental arches' normal evolution can be noted such as premature loss of primary teeth[12]. Sequels resulting from premature loss of primary anterior teeth may negatively affect eruption of permanent successor teeth[13]; promote the establishment of malocclusion in permanent dentition[14] and damage to primary arch integrity[15]. As the consequences of premature loss of primary anterior teeth are controversial, poorly studied and evidence is outdated, it is important to monitor children's occlusion development in order to evaluate the need to intervene[16].

In this context, digital scanners and digital study models should be beneficial for pediatric dentists during the occlusion monitoring to avoid unnecessary treatments and costs[11]. Considering technological progress, the introduction of digital models has become a reality in late 1990s[5]. Since then, many studies have replaced dental plaster models by digital models to facilitate diagnosis and treatment plan[17]. Following that, systematic reviews have shown that digital models are as reliable as plaster models, with high agreement and reproducibility[3,7,18].

Then, the purpose of the present study was to assess which measurement instrument would be the most advantageous for pediatric dentistry clinics. To achieve this, reproducibility and agreement of dental linear measurements were performed on digital models through software and plaster models both with compass and digital caliper. Agreement assesses how closely different instruments agree with each other in measuring the same object, while reproducibility is related to repetition. Thus, it is the degree to which measurements are repeated under the same conditions[19].

Nevertheless, there is little scientific evidence published in the literature evaluating the application of digital models specifically for measurements in primary dentition[11]. Such evidence would be important since the primary arch has different characteristics from the permanent arch, such as: number of teeth, arch dimensions, dental sizes, among others[10]. Therefore, the present study aimed to assess reproducibility and agreement of dental linear measurements performed specifically on digital models of infants and pre-school children.

Every practitioner should assess and guide the occlusion during dental attendance toward optimal outcomes[10]. It contributes not only for early diagnosis of oclusal changes, but also for treatment decisions regarding space management; use of space maintainers and other appliances; or even primary teeth extraction[16]. Such management of developing occlusion can be done in infants and children through clinical examination and complementary exams, including study models analysis[21]. To monitor the development of primary dental arches, the research included plaster models with primary dentition (complete or incomplete) from infants and children.

During the appropriate occlusion supervision, pediatric dentist may be faced with premature loss of primary anterior teeth, which also indicates the need for monitoring the emergence of dimensional arch changes because of this loss[22]. Also, supervising children developing occlusion after premature loss of primary anterior teeth becomes essential since its sequels are still controversial, poorly studied and evidence is outdated[23]. Besides the inclusion of models without any tooth/teeth loss, models of patients with premature loss of primary incisors and canines were also included for the dental linear measurements of the present study.

Dental linear measurement is derived when two reference points are connected to obtain dental sizes or distances in dental arches, for example[10]. It is an

important step in diagnosis procedure, treatment plan and definition of follow-up periods. Regarding linear measurements, the most used for dental arches evaluation are: tooth sizes or tooth loss space (if any), arch perimeter, arch width, arch length, intercanine width and intercanine length[8,11]. These six dental linear measurements were used both for measurements in physical and digital study models.

Performing digital measurements through software has become a reality in dental offices[16] since there are some disadvantages to the use of plaster models, such as: difficulties of storage, risk of fracture and physical damage in measuring procedure[17]. Among advantages of using digital models, possibility of store and reuse created images in software and also share them with other clinicians or multidisciplinary departments can be highlighted[18].

Regarding agreement, Bland-Altman test compared the three different measurement instruments – compass, digital caliper and software – to indicate if there was agreement between them. The result showed that agreement between instruments was good with mean difference ranging from 0.034mm (-1.077; 1.145) to -1.002mm (-2.632; 0.627). The highest results show that mean difference between digital caliper and software range -1.002mm in arch perimeter. This fact can be understood by the method acquisition, since for the arch perimeter measurement, it is necessary to divide dental arch in six sectors, measuring them individually – molars, canine and incisors of the right hemi-arch, and molars, canine and incisors of the left hemi-arch – and then adding them up.

Reproducibility of quantitative measurements obtained by different operators was assessed through the inter-rater ICC test. The ICC is a parameter widely used in scientific research to measure correlation between evaluation samples between two or more evaluators when there is a quantitative variable. Koo and Li[24] suggested that

values less than 0.5 are poor, between 0.5 and 0.75 are moderate, between 0.75 and 0.9 are good, and greater than 0.9 are excellent. ICC results from the present study were considered excellent with values ranging from 0.93 to 1.00. It means that these instruments have the property of repeating similar results with different examiners.

Current findings corroborate results presented in most recent systematic reviews from scientific literature[3,7,18,25] and, also provide additional information about the possibility of performing digital measurements made on plaster models after digitalization in pediatric dentistry clinic. But it is worth mentioning that the measurement instrument should be the one that best fits the reality of each dentist. Therefore, professionals need to evaluate advantages and disadvantages of each instrument in terms of value, acceptability by the patient, practicality, and most importantly, availability at the time of the appointment.

CONCLUSION

Based on the results obtained from this research, dental linear measurements performed in digital models obtained by scanning plaster model achieve excellent reproducibility and good agreement compared to compass and digital caliper. All measurement instruments should be safely used in dental clinical practice.

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Table 1. Dental linear measurements used to evaluate occlusion development.

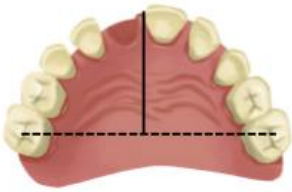
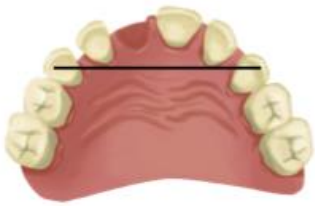
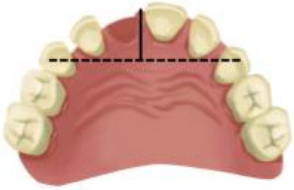
Variable	Definition	Illustration
(1) Missing tooth space	Determined by the distance between the interproximal surfaces of the teeth adjacent to the missing tooth.	
(2) Arch perimeter	Measurement of the arch from the distal midpoint of the primary second molar (or the last tooth present in the arch) from one side to the other side.	
(3) Arch width	Distance between central fossae of occlusal surface of primary second molars or primary first molars, if those were not present.	
(4) Arch length	Perpendicular distance from contact point of central incisors to the line between the central fossae of the occlusal surfaces of primary second molars or primary first molars, if those were not present.	
(5) Intercanine width	Distance between the cusp tips of primary canine.	
(6) Intercanine length	Perpendicular distance from contact point of central incisors to the line passing through the cusp tips of primary canines.	

Table 2. ICC reproducibility showing agreement and consistency values in dental linear measurements using compass, digital caliper and software instruments between two operators.

Variables	Dental arch	Compass		Digital caliper		Software	
		Agreement	Agreement	Consistency	Consistency	Agreement	Consistency
Tooth loss space	Upper	0.999	0.999	0.999	0.999	0.999	0.999
Arch perimeter	Upper	0.994	0.996	0.997	0.996	0.991	0.994
Arch width	Upper	0.987	0.992	0.993	0.988	0.996	0.996
Arch length	Upper	0.991	0.993	0.995	0.991	0.957	0.960
Intercanine width	Upper	0.999	0.999	0.999	0.999	1.000	1.000
Intercanine length	Upper	0.992	0.984	0.990	0.993	0.993	0.994
Tooth loss space*	Lower	-	-	-	-	-	-
Arch perimeter	Lower	0.998	0.998	0.998	0.999	0.998	0.998
Arch Width	Lower	0.988	0.986	0.986	0.990	0.972	0.972
Arch Length	Lower	0.994	0.989	0.989	0.993	0.984	0.983
Intercanine width	Lower	0.998	0.996	0.997	0.999	0.999	0.999
Intercanine length	Lower	0.963	0.928	0.933	0.961	0.930	0.943

*** Note: There is no value because there was no tooth loss in the lower arch.**

Table 3. Bland-Altman values comparing the measurement instruments.

Dental linear measurement	Measurement instruments	Dental arch	n	Bias (mm)	Lower limit of agreement (mm)	Upper limit of agreement (mm)
Tooth loss space	Digital caliper x software	Upper	20	-0.048	-0.456	0.359
Arch perimeter	Digital caliper x software	Upper	20	-1.002	-2.632	0.627
Arch width	Digital caliper x software	Upper	20	0.258	-0.961	1.476
Arch length	Digital caliper x software	Upper	20	-0.199	-1.291	0.894
Intercanine width	Digital caliper x software	Upper	20	-0.109	-0.839	0.622
Intercanine length	Digital caliper x software	Upper	20	0.162	-1.101	1.424
Tooth loss space	Digital caliper x software	Lower	20	0.00	0.00	0.00
Arch perimeter	Digital caliper x software	Lower	20	-0.807	-2.246	0.631
Arch width	Digital caliper x software	Lower	20	0.287	-1.357	1.931
Arch length	Digital caliper x software	Lower	20	-0.185	-1.518	1.148
Intercanine width	Digital caliper x software	Lower	20	0.111	-0.701	0.922
Intercanine length	Digital caliper x software	Lower	20	0.065	-1.268	1.398
Tooth loss space	Compass x software	Upper	20	-0.163	-0.743	0.418
Arch perimeter	Compass x software	Upper	20	-0.633	-2.501	1.235
Arch width	Compass x software	Upper	20	0.034	-1.077	1.145
Arch length	Compass x software	Upper	20	-0.388	-1.593	0.818
Intercanine width	Compass x software	Upper	20	-0.060	-0.865	0.745
Intercanine length	Compass x software	Upper	20	0.044	-0.915	1.003
Tooth loss space	Compass x software	Lower	20	0.00	0.00	0.00
Arch perimeter	Compass x software	Lower	20	-0.228	-2.276	1.820
Arch width	Compass x software	Lower	20	0.034	-1.637	1.706
Arch length	Compass x software	Lower	20	-0.23	-2.72	2.26
Intercanine width	Compass x software	Lower	20	0.095	-0.608	0.799
Intercanine length	Compass x software	Lower	20	0.175	-0.844	1.194

Figure 1. A- Compass measurements; B- Digital caliper measurements; C- Digital measurements.

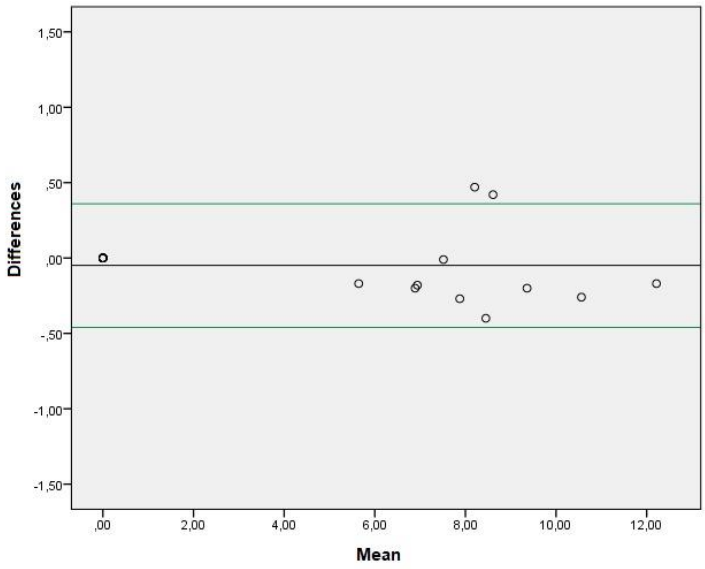


Figure 2. Bland–Altman plot showing the difference between digital caliper and software of “tooth space loss” measurements.

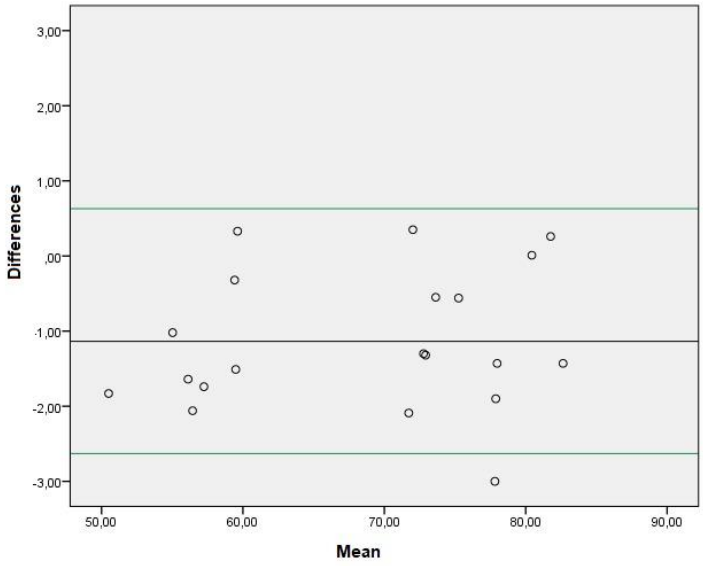


Figure 3. Bland–Altman plot showing the difference between digital caliper and software of “arch perimeter” measurements.

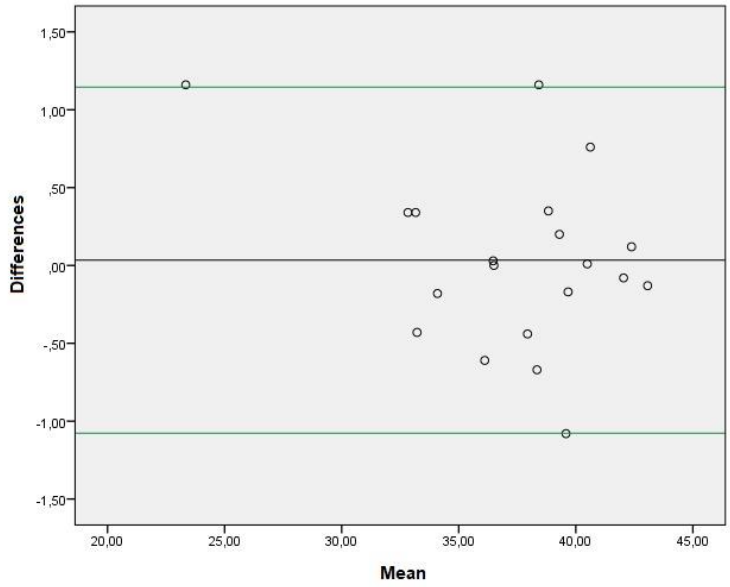


Figure 4. Bland–Altman plot showing the difference between compass and software of “arch width” measurements.

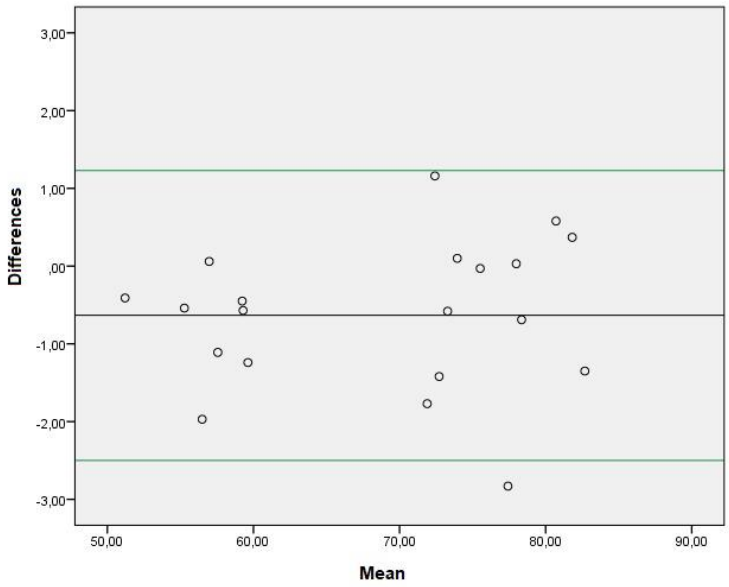


Figure 5. Bland–Altman plot showing the difference between compass and software of “arch perimeter” measurements.

4.5 Artigo 4: How to clinically measure the space of premature loss of primary anterior teeth? An agreement and reproducibility study comparing compass and digital caliper.

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ABSTRACT

The aim of the study was to compare two clinical measurement instruments – compass and digital caliper – to measure space after premature loss of primary anterior teeth due to traumatic dental injuries (TDI). The sample consisted of 15 infants and children from both sex, aged from 2 to 6 years old with mean age 5.07 (1.14) years, presenting primary anterior teeth lost from avulsion or extraction due to TDI. Two trained operators individually measured missing tooth/teeth space – determined by the distance between interproximal surfaces of adjacent teeth to tooth/teeth lost – both with a compass and digital caliper directly on patient's oral cavity. Descriptive and inferential statistical analyses were performed. Difference in means between the instruments were evaluated with Student's T-test. Bland-Altman test was used to analyze agreement between the instruments. Inter-rater reproducibility was calculated using intraclass correlation coefficient (ICC). Sample presented one to four primary anterior teeth lost or extracted. Types of teeth lost were: only 51 (26.7%), only 61 (13.3%), only 62 (6.7%), 51 and 61 together (33.3%), and more than 3 teeth (20%). T-test showed no statistically significant difference between the instruments, indicating agreement between them, regardless of the operator (p=0.658; p=0.184). This concordance was also evidenced in the results of the Bland-Altman analysis. The inter-rater ICC was considered excellent with mean ICC value being 0.999, indicating high reproducibility. Compass and digital caliper matched with each other; hence, both instruments could be safely used for clinical space measurement of missing primary anterior teeth.

Key words: Tooth Loss, Deciduous Teeth, Incisor, Cuspid, Dimensional Measurement Accuracy, Reliability of Results.

INTRODUCTION

Primary teeth loss is considered premature when tooth is lost or extracted before physiological exfoliation time while the permanent successor tooth hasn't begun its active eruption, compatible with stage 6 of Nolla, in which crown formation is completed and there is less than 2/3 of root formation, evidenced through radiographic exam (Nolla, 1960, Hernández-Palacios et al., 2022). The most common etiologies of premature tooth loss are: advanced dental caries, premature root resorption, neonatal tooth extraction and traumatic dental injuries (TDI) (Nadelman et al., 2020-a).

When traumatized primary anterior teeth are lost prematurely, some complications may occur to the infant/child, including: speech impairment (Adewumi et al., 2012; Lamberghini et al., 2012), onset of non-nutritive habits (Hawes, 1966; Wright and Friedman, 1985), misalignment and delayed eruption of the permanent successor tooth (Ravn, 1975), onset of malocclusion in permanent dentition (Miyamoto et al., 1975), and space loss (Holan and Needleman, 2014). Space loss would be a result of spontaneous drifting of the adjacent teeth into the edentulous space from anterior tooth/teeth loss (Holan and Needleman, 2014). However, its occurrence is still a controversial issue (Nadelman et al., 2020-b).

Since the consequences and treatment requirement after premature loss of primary anterior teeth still debatable, dentists should follow up child's occlusion development and monitor the missing tooth space over time (Nadelman et al., 2021). For this, different instruments can be employed to measure missing tooth space, including compass and digital caliper (Nadelman et al., 2020-a). While both instruments are widely used in clinical

dentistry routine, there is little data in the literature comparing the two instruments regarding its effectiveness and use, to the best of our knowledge.

Thus, the present study aimed to evaluate whether the instruments agree in clinical measurement of missing tooth/teeth space and if they are reproducible for the purpose of measuring space from premature loss of primary anterior teeth in infants and children.

METHODOLOGY

Study design

The present agreement and reproducibility study was reported following the Guidelines for Reporting Reliability and Agreement Studies (GRRAS) (Kottner et al., 2011). Research Ethics Committee approved the study (approval number: 02502818.7.0000.5257, emendation 3, report number: 5.621.927) and an Informed Consent Form was provided to all tutors allowing participation of infants and children. Eligible participants who sought care at the Department from November 2021 to November 2022 composed this convenience sample.

Sampling method – participants and eligibility criteria

The inclusion criteria consisted of infants and children, in their primary or mixed dentition, from zero to six years old, including both sex that had premature lost of one to four primary incisor(s) or canine(s) due to TDI. To be included the participants should be in good general health, and do not use orthodontic or orthopedic appliances.

The exclusion criteria were: when the patient presented definitively negative behavior (Frankl et al., 1962), making the space clinical measurement impossible; or presented special needs (developmental syndrome, and neurological, psychological or psychiatric disorders); or cleft lip and/or palate.

Clinical assessment

All the patients included in this study were undergoing follow-up at the Centro de Vigilância e Monitoramento de Traumatismos Dentoalveolares of Dental School from Universidade Federal do Rio de Janeiro (CVMT®/FO-UFRJ), where the TDI was diagnosed and managed. TDI monitoring includes clinical examination, intraoral photographs and radiographs, regular follow-up visits and treatment, when necessary.

Measurement/rating process

Concerning the characteristics of operators, two PhD students (operator 1 – P.N. and operator 2 – C.A.) from the Department of Pediatric Dentistry and Orthodontics of School of Dentistry from Universidade Federal do Rio de Janeiro were trained by an experienced Orthodontic professional (E.O.A.V.) to perform the measurements. The operators (P.N. and C.A.) independently measured the missing tooth/teeth space directly on patient's oral cavity both with a compass with pointer on both sides (ICE, Cajamar, São Paulo, Brazil), and a digital caliper (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japan). The measurement wasn't performed on the tooth

extraction day either because of blood fluids or since the patient was already sensitized to the surgical procedure.

To obtain blinding, operator 1 performed the first measurement with the compass, without transferring value, followed by the measurement with the digital caliper. After that, the operator 2 performed the same procedures, without the knowledge of the first operator measurements. A third operator, using always the same plastic ruler (Acrimet®, São Bernardo do Campo, São Paulo, Brazil), quantified the values obtained by the two operators when they used the compass and wrote down, avoiding inter-rater bias.

The missing tooth/teeth space was determined as the linear distance between the most prominent points of interproximal surfaces of teeth adjacent to edentulous space (Figure 1).

Statistical analysis

The analysis was performed using descriptive and inferential statistics. The descriptive data included mean age, gender, type of tooth lost.

The inferential analysis began in Excel® 2010 (Microsoft Corporation, Redmond, WA, USA), where the values of the difference between the instruments, mean, mean of differences, standard deviation, upper and lower limits of the 95% confidence interval were tabulated. In SPSS® software, version 21.0 (SPSS Inc., Chicago, IL, USA) difference in means between instruments were evaluated through Student's T-test. Bland-Altman test was used to evaluate method precision and systematic error, demonstrating if there was agreement between the instruments. Proportion bias was calculated by the simple linear regression analysis to indicate homogeneity of

differences distribution around the mean value. This bias was identified in $p<0,05$.

ICC was also applied to calculate inter-rater reproducibility of instruments. The classification defined the degree of consistency as proposed by Koo and Li (2016) in which the ICC value were ranged as: < 0.5 = poor; 0.5 – 0.75 = moderate; 0.75 –0.9 = good; > 0.9 = excellent. For all analysis the 95% confidence interval was considered.

RESULTS

Sample characterization

Totally, 15 infants/children were included, aged between two and six years (mean, 5.07 ± 1.14 years) of both sex (10 males, 5 females). Regarding the type of tooth, all teeth lost were maxillary primary anterior teeth, being the upper primary central incisors the most affected teeth. With respect to the amount of missing teeth, the number range from one to four, with 46.7% having only one primary central incisor lost; 33.3% both primary central incisors; 13.32% both primary central incisors plus one primary lateral incisor; and 6.68% including also a primary canine (Table 1).

Agreement results

No significant difference was observed in differences' values between the instruments for the two operators (Student's T-test, $p>0.05$), indicating agreement between the numbers obtained both with compass and digital caliper (Table 2).

The mean difference values between both measurement instruments and the 95% agreement limits presented by the Bland-Altman analysis (Table 2) confirmed the agreement between compass and digital caliper (Figure 2 and 3).

The proportion bias evaluated by the simple linear regression analysis showed non-significant values for operator 1 and 2, respectively (bias values p= 0.224 and 0.950), which indicates homogeneity of the differences around the mean, configuring the absence of this bias (Table 2).

Reproducibility *results*

Reproducibility among the operators revealed an excellent ICC either for compass or for digital caliper measurements showing values ranging from 0.997 to 0.999 (Table 3).

DISCUSSION

It is well known that premature loss of primary posterior teeth is a potential cause for space loss in dental arches (Kaklamanos et al., 2017). However, there is lack of knowledge in the literature about space changes after premature loss of primary anterior teeth (Nadelman et al., 2020-b). In order to provide scientific evidence on the subject and develop further controlled observational studies, high quality methodology needs to be improved (Nadelman et al., 2021). Select and standardize the instrument to quantity space changes in dental arches would be the first step to achieve this. Therefore, the present study aimed to compare two different instruments

– compass and digital caliper – to clinically measure missing tooth/teeth space and select which one is more reproducible for future researches.

Regarding these instruments, compass is a device composed of two articulated rods joined by a point that allows opening and closing the rods reaching a precise measurement (Compasso, 2020). And digital caliper is an instrument used to measure internal, external, and depth linear dimensions of an object (Infopédia, 2023). It consists of a graduated ruler, with a fixed stop, on which a slider slides. The digital display facilitates measurement's fast reading and improves statistical control (Toginho Filho et al., 2010).

In relation to agreement evaluation, Bland-Atman test was used to compare compass and digital caliper indicating agreement degree between them. When the instruments agree 100% (maximum agreement), p value = 0; and when $p < 0.05$, there is statistical difference between them, and thus they do not agree on their measurements. The present result showed that there is agreement between the compass and digital caliper for measurements performed by operators. This indicates that both instruments could be safely used to measure missing teeth space. It agrees to a previous case series (Nadelman et al., 2020-a) that used both instruments to minimize bias and reported no statistical difference between them, considering the limitations of the study design and also de lack of numerical data reporting.

Reproducibility of quantitative measurements obtained by different operators was assessed through inter-rater ICC test. This test measures correlation between evaluation samples from two or more evaluators. The ICC analysis displayed excellent reproducibility inter-rater. This result can provide important role in measurement instruments standardization for researchers

who want to use them in the future, and lay a preliminary basis for methodological comparative research (Liu et al., 2021). It is also important to emphasize the present limitation of not having the intra-rater analysis. This analysis wasn't carried out since space could be lost between the first and the second measure, resulting in a difference between the values. This would not be related to the examiner.

Since the present study showed that both the compass and the digital caliper could be used to measure missing teeth space with excellent agreement and reproducibility, the choice which of instrument to use in dental clinic could be based on other characteristics, such as: child acceptability, price, practicality, easy handling. Despite there are no articles in the literature comparing these features, some details about each instrument could be highlighted and commented.

With regard to child acceptability, it is important mentioning that most severe TDI in primary teeth occur mainly between one and three years old (Sennhenn and Jacobs, 2006) and likewise premature loss of primary anterior teeth affects infants and children which age usually range from 0 to 5 years old (Mc Donald and Avery, 2011). These individuals usually present fear during dental care both because of young age and previous experience of trauma. Great majority of the present sample showed fear of the sharp point of both instruments during missing tooth/teeth space measurement. This also shows that regardless of the instrument chosen, pediatric dentist or orthodontist need to use behavior management techniques to measure space.

Among advantages of digital caliper, its greater precision can be highlighted. The compass, on the other hand, does not present range in

decimal places, but it is a simple, small instrument and easier to handle. With respect to the disadvantages, digital caliper is a large instrument, more difficult to handle and measure; and compass is less practical because it needs to transpose its results onto a ruler.

Considering the differences in instruments prices, the digital caliper from Mitutoyo is approximately 4 times the value of compass from ICE. On the other hand, if digital calipers and compasses from generic brands are selected, the instruments' values become equal, or even the digital caliper being cheaper than the compass. As dental measurements need high precision, it is suggested that digital calipers and compasses from well-known and safe brands are used for this purpose.

Moreover, technological development has been transforming and advancing dentistry, including dental measurements (Çayönü et al., 2019). As a result, traditional measurement with compass or digital caliper now becomes possible with digital instruments (Warnecki et al., 2022). For patients with phobia of measuring directly in oral cavity – which was the reason for exclusion of participants from the study – direct measure could be replaced by digital. However, further clinical studies are still required to possibly replace the instruments with proven evidence.

CONCLUSION

Both instruments are effectives for measuring the space of premature loss of primary anterior teeth, and can be used with high agreement and reproducibility in future studies and also in clinical practice. The choice of which instrument to use depends on the researcher or clinical dentist, taking

into account good sense, patient age and behavior, child acceptability, practicality, operator experience and cost.

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TABLES

Table 1. Sample characteristics (n=15)

Variables	n	%
Sex		
Male	10	66.7
Female	5	33.3
Age (years)		
≤2	2	13.3
>2	13	86.7
N° teeth lost		
1	7	46.7
2	5	33.3
3	2	13.3
4	1	6.7
Type of teeth lost		
Upper central incisor	22	81.5
Upper lateral incisor	4	14.8
Upper canine	1	3.7

Table 2. Bland–Altman results of comparison between compass and digital caliper measurements of missing teeth space from each operator 1 and 2.

Comparison	Mean differences	SD	Bias‡	95% Confidence Interval		p-value*
				Upper	Lower	
Compass x digital caliper (operator 1)	-0.03	0.30	0.224	0.55	-0.62	0.658
Compass x digital caliper (operator 2)	-0.17	0.48	0.950	0.77	-1.11	0.184

Notes: *T-test: p>0,05 indicates agreement between the instruments;
*Simple linear regression (p<0,05); bias: p>0.05 indicates homogeneity of the distribution of differences around the mean.

Table 3. ICC results of comparison between the operators' measurements.

Comparison	ICC	95% Confidence Interval	
		Upper	Lower
Compass (operator 1) x compass (operator 2)	0.999	1.000	0.996
Digital caliper (operator 1) x Digital caliper (operator 2)	0.999	1.000	0.997

FIGURES

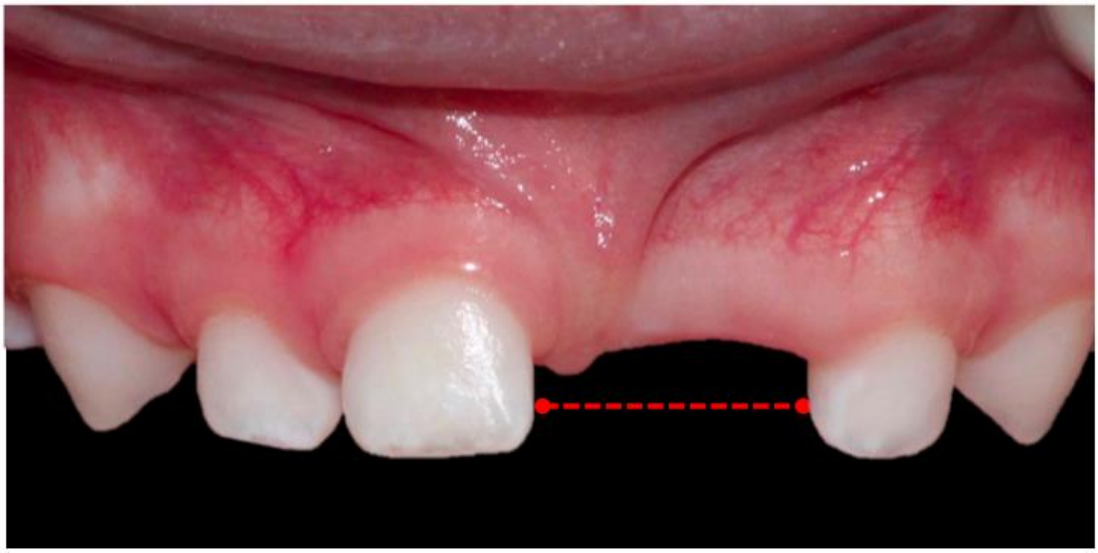

Figure1. Missing tooth/teeth space determination: the linear distance between the most prominent points of interproximal surfaces of teeth adjacent to edentulous space

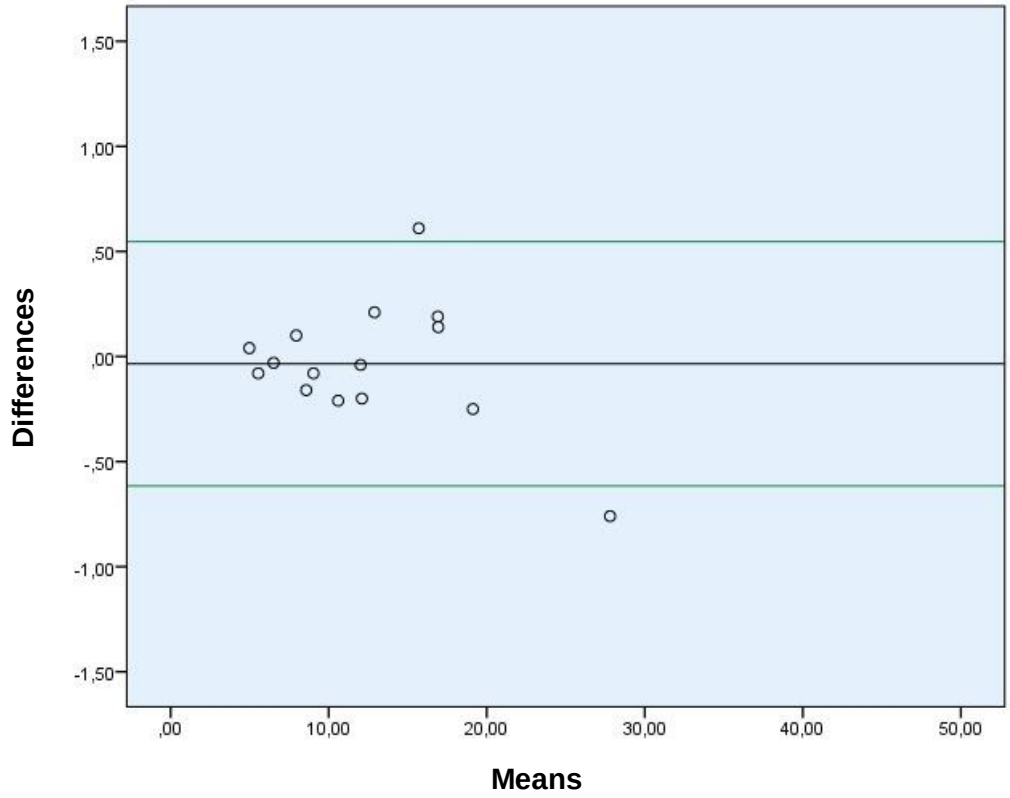

Figure2. Bland-Altman plot for compass and digital caliper measurements from operator 1. The center line represents the mean of the differences and the upper and lower green line represent the 95% confidence interval limits.

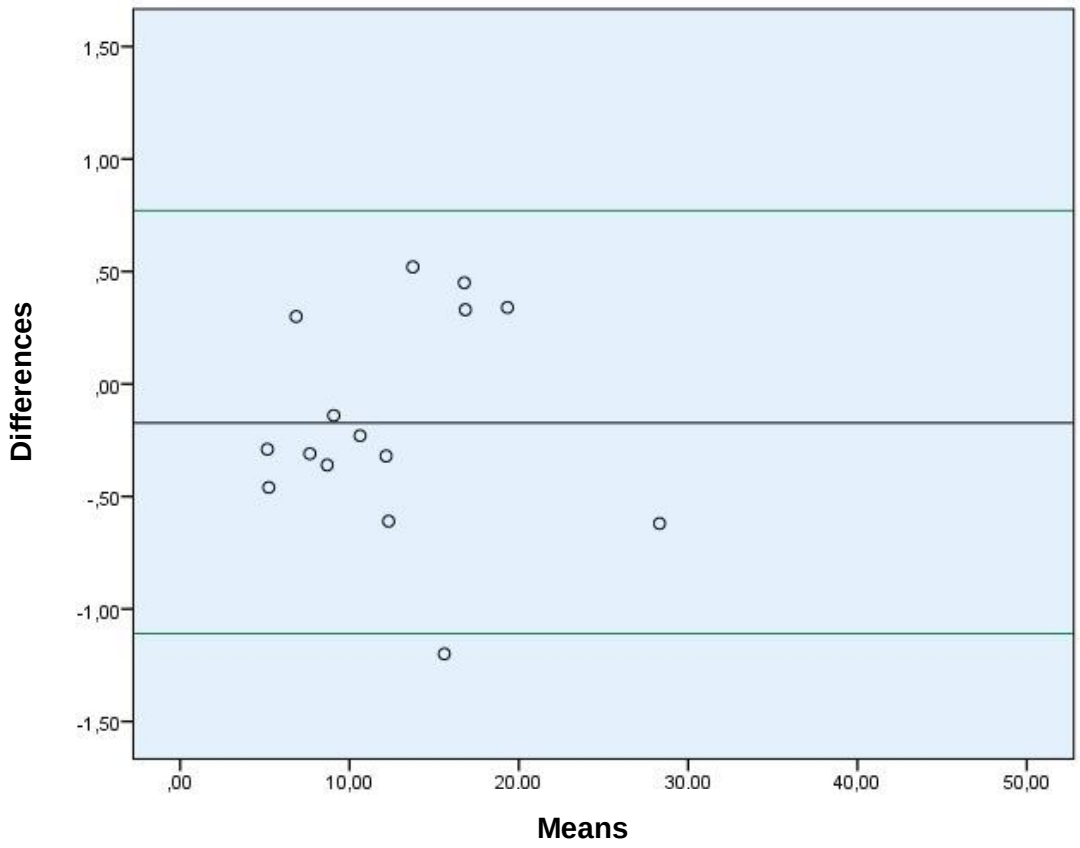

Figure3. Bland-Altman plot for compass and digital caliper measurements from operator 2. The center line represents the mean of the differences and the upper and lower green line represent the 95% confidence interval limits.

4.6 Artigo 5: Occlusion development after premature loss of primary anterior teeth: preliminary results of a 24-month prospective cohort study.

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ABSTRACT

Aim: The study aimed to longitudinally evaluate occlusion development of infants and children after premature loss or extraction of primary anterior teeth compared to infants and children without teeth losses, through a prospective cohort study. **Methodology:** Sample consisted initially of 21 infants and children aged 1 to 5 years old presenting loss or extraction of primary anterior teeth and without tooth losses. A trained operator initially performed participants' occlusion examination, clinically measured missing tooth/teeth space – if any –, recorded through intraoral photographs, and impression of upper and lower arches for confection of study models of each infant/child. These steps were performed at baseline (T0) and repeated after 24 months (T1) follow up. Models were scanned using the optical 3D scanner (Open Technologies, Rezzato, Lombardy, Italy) and a trained and calibrated operator performed dental linear measurements with Autodesk Meshmixer program (version 3.5.474, California, United States) on digital models. Six measurements were evaluated: missing tooth space – MTS (if any), arch perimeter, arch length, arch width, intercanine length and intercanine width. All digital measurements were repeated after a 1-month interval for evaluation of method error. Data were tabulated. Descriptive and statistical analyses were performed using Jamovi (version 2.2, Sydney, Australia) under Wilcoxon test to calculate clinical MTS alteration, intraclass correlation coefficient (ICC) to calculate inter-rater reproducibility, Bland-Altman to evaluate method precision, t-test to compare changes in dental linear measurements and Levene's to evaluate normality of variances. **Results:** After 6 patient's dropouts, fifteen patients with mean age of 2.93 (± 1.18) years old were included. Both groups showed changes in dental arches and occlusion after 24 months including: exfoliation and eruption of primary teeth, eruption of permanent teeth, self-correction or establishment of malocclusion, among others. However, preliminary results show there were no statistical differences in clinically measured MTS ($p > 0.05$), and in arch perimeter, arch length, arch width, intercanine length, intercanine width digitally measured of both exposed and non-exposed groups ($p > 0.05$). ICC ranged from 0.73 to 1.00. Method precision was adequate and there was no evidence of proportion bias ($p > 0.05$). **Conclusion:** Although there were no statistical difference in dental arches and occlusion development of infants and children of both groups, physiological and pathological changes were diagnosed through qualitative analysis, and reinforce the importance of clinical evaluation and follow-up during dentition and occlusion development.

Key words: Tooth Loss, Deciduous Teeth, Incisor, Dental Occlusion, Dental Model, Digital Technologies.

INTRODUCTION

The development of dental occlusion is a continuous process of long-term occurrence from the sixth week of intrauterine life to approximately 20 years of age (McDonald, Avery and Dean, 2011). Knowledge about normal characteristics of dentition at different stages is essential to recognize and diagnose deviations from normality in an early stage and to perform the appropriate treatment, when it is necessary (Maia et al., 2012).

Primary teeth are the first to erupt in the oral cavity. Deciduous dentition evolution is extremely relevant as it provides dental arches' development from alveolar bone matrix, as well as guidance for the eruption of permanent teeth. In general, the eruption period of primary teeth extends from 6 months to 2.5 years of age, and by the age of 3 years, the primary dentition is completely established (Silva Filho and Garib, 2013).

Genetic and environmental factors can influence the normal development of dental arches and occlusion (Mossey, 1999). Among the environmental factors, the premature loss of primary teeth can be highlighted. Tooth loss is considered premature when the primary tooth is lost before the permanent successor has begun its active eruption, compatible with stage 6 of Nolla, in which crown formation is completed and there is less than 2/3 of root formation, evidenced through radiographic exam (Nolla, 1960).

In this sense, premature loss of primary anterior teeth could cause morphological, functional and psychosocial damage to the infant/child (Nadelman et al., 2021). It is believed that morphological consequences might include interferences in eruption of permanent successors teeth and

impairment of arch integrity (Holan and Needleman, 2014). However, there are gaps in the scientific literature about the real effect of premature loss of primary anterior teeth in dimensional arch changes in primary arch, and how it affect permanent tooth alignment and occlusion establishment (Nadelman et al., 2021).

The few studies found in the literature are outdated and present substantial methodological flaws, including: lack of comparison group (Medina et al., 2010), absence of numerical data (To, 1991), non-specification of type of teeth lost (Pedersen et al., 1978), premature loss or extraction due to crowding and ectopic eruption of permanent lateral incisors (Kau et al., 2004), and assessment of both anterior and posterior tooth loss (Clinch and Healy, 1959; Miyamoto et al., 1975; Magnússon, 1979; Kerr, 1980). Consequently, there is little robust scientific evidence for the clinical practice decisions. To the best of our knowledge, the present study is the first cohort study to evaluate changes in dental arches and occlusion development of infants and children who have suffered premature loss or extraction of primary incisor(s) and/or canine(s), compared to infants and children without teeth losses, through a 24-month follow-up period.

METHODOLOGY

The report of the preliminary data of the present prospective cohort study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (von Elm et al., 2007).

Study design

The present study is an observational longitudinal prospective cohort study which aimed to evaluate dental arches and occlusion development of infants and children aged 0 to 6 years who had premature lost or extraction of primary incisor(s) and/or canine(s) compared to infants and children without any premature loss or extraction.

Setting

Research Ethics Committee approved the study protocol (approval number: 02502818.7.0000.5257, report number: 5.621.927) and an Informed Consent Form was provided to all of tutors allowing participation of infant/child in the study. Eligible participants who sought care at the Centro de Vigilância e Monitoramento de Traumatismos Dentoalveolares (CVMT®) and at the Infant Clinic of the Department of Pediatric Dentistry and Orthodontics of School of Dentistry from Universidade Federal do Rio de Janeiro (UFRJ) composed the study sample.

Participants' recruitment period occurred between April 2019 and March 2020. The study aimed to evaluate participants at baseline (after premature loss, if any) and review them at follow-up visits 6 and, originally, 12 months later. However, due to the COVID-19 pandemic, participants were only evaluated at baseline (T0) and after at least 24 months (T1). Thus, data collection had to be carried out in two periods: April 2019 to March 2020; and November 2021 to April 2022.

Participants

The inclusion criteria for the exposed group were infants and children aged from 0 to 6 years with premature loss or extraction of one or more maxillary or mandibular incisors and/or canines due to trauma, caries or neonatal teeth; good general health; complete or incomplete primary dentition or mixed dentition; absence of cavitated carious lesions and/or restorations; absence of non-nutritive habits; malocclusions and/or oral appliances. The same inclusion criteria were applied to non-exposed group, except that this group consisted of individuals with no tooth loss or extraction.

The exclusion criteria for both groups were infants and children with special needs, loss or extraction of primary posterior teeth; previous or ongoing orthodontic or orthopedic treatment; cleft lip and/or palate; not meeting any of the inclusion criteria; or when the guardian refused to participate of the study.

Variables

A trained and calibrated operator (ICC ranging from 0.93 to 1.00) (P.N.) performed data collection. After concluding anamnesis, participants underwent an intraoral examination, recording characteristics of the occlusion such as: type of dentition (primary complete or incomplete or mixed dentition), Baume's deciduous dental arch type (type I or II) and relationship of canines (class I, II or III). For participants with premature loss of primary canines or those who had no fully erupted canines, relationship of canines was not classified.

Tooth loss was considered premature when it was lost or extracted before physiological exfoliation time while the permanent successor tooth hasn't begun its active eruption, compatible with stage 6 of Nolla, in which crown formation is completed and there is less than 2/3 of root formation, evidenced through radiographic exam (Nolla, 1960).

Patients from exposed group underwent radiographic examination for trauma monitoring in CVMT® and consequent inclusion in the present study. The operator measures the MTS, in exposed group, directly on patient's oral cavity with a digital caliper (Absolute Digimatic Caliper, Mitutoyo, Kawasaki, Japan). MTS was determined as the linear distance between the most prominent points of interproximal surfaces of teeth adjacent to edentulous space.

Intraoral recording was carried out through intraoral photographs and study models. Frontal intraoral photographs were performed with a Canon Eos Rebel T3i digital camera, macro lens (Tokina 100/2.8 AT-X PRO D CANON), circular flash (Macro Circular Meike Mk-14ext – Canon) and with the aid of frontal infant lip retractors. When photograph of patient's occlusion was not possible due to lack of cooperation, intraoral photographs of dental arches out of occlusion were taken.

Upper and lower arches impressions were taken with alginate Orthoprint Tipo I (Zhermack, Badia Polesine, Italy) in standard perforated plastic (Maquira, Maringá, Paraná, Brazil and Morelli, Sorocaba, São Paulo, Brazil) or aluminum trays (Tecnodent, Indaiatuba, São Paulo, Brazil), depending on the patient's dental arch size.

Study models were created with special orthodontic plaster (Asfer Indústria Química Ltda, São Caetano do Sul, São Paulo, Brazil) in proportion recommended by the manufacturer. Models were prepared and cut according to proposals from the literature (Camargo and Mucha, 1999).

Models completely finished were numbered in a blind way and individually scanned using the optical 3D scanner (Open Technologies, Rezzato, Lombardy, Italy). Models scanning sequence consisted of scanning the upper model, then the lower model and, lastly, the occluded models, to obtain inter-arches relation, as well as sagittal, vertical and cross-section adjustment of intercuspation.

The entire process described above – occlusion examination, MTS measurement, intraoral photographs, upper and lower arches impressions, study models preparation and models scanning – was performed in two different time points: at T0 and T1.

Data sources/measurement

Six dental linear measurements concerning to dental arch development were considered (Padma Kumari and Retnakumari, 2006): (1) MTS (only in the exposed group), (2) arch perimeter, (3) arch width, (4) arch length, (5) intercanine width and (6) intercanine length. For participants with premature loss of primary canines or those who had no fully erupted canines, intercanine width and intercanine length were not measured.

A trained and calibrated operator (P.N.) digitally performed dental linear measurements in a blinded way using the Autodesk Meshmixer program (version 3.5.474, California, United States) (Yousefi et al., 2021). All

digital measurements were repeated after a 1-month interval for evaluation of method error.

Bias

After data collection had already started, COVID-19 pandemic broke out and interrupted the recruitment of eligible patients since clinical activities at Department of Pediatric Dentistry and Orthodontics of School of Dentistry were suspended from March 2020 to November 2021. Thus, a non-probabilistic sample was adopted and the follow-up period for participants already included has increased from 12 to 24 months. Recruitment proposal for the subjects planned for sample pairing by gender and age. This pairing could not be guaranteed also because of COVID-19.

Statistical analysis

Statistical analysis was performed using the Jamovi program, version 2.2 (Sydney, Australia), adopting a significance level of 0.05%. Descriptive statistics were used to present data (absolute relative frequency and mean and standard deviation for dental arch measurements). A comprehensive descriptive analysis was performed through clinical evaluation and photographs of each patient comparing T0 and T1. Physiological and pathological changes in T0 and T1 were observed and highlighted in the descriptive analysis.

The Wilcoxon test was used to evaluate if there was clinical changes in MTS. The ICC was used to calculate the inter-rater repeatability. Bland-Altman test was applied to evaluate method agreement and systematic error

by estimating the ratio bias. Shapiro-Wilk test was used to verify data normality. Once normality was verified, the t-test was employed to compare the changes in dental linear measurements between the exposed and non-exposed group. Levene's test was used to evaluate normality of variances.

RESULTS

Twenty-one infants and children initiated the present cohort study, however, after interruption of clinical activities due to COVID-19 pandemic, 6 patients (28,57%) dropped out. Thus, the sample consisted of 15 infants and children distributed into exposed (n = 9) and non-exposed group (n = 6) with mean age of 2.93 (± 1.18) years old at baseline. Regarding the sex, 6 patients (40%) were boys and 9 patients (60%) were girls (Table 1). All premature losses occurred as a result of dento-alveolar trauma.

Concerning occlusion characteristics at the beginning of the study, 5 participants (33.3%) presented incomplete primary dentition, 9 participants (60%) presented complete primary dentition and just one patient (6.7%) presented mixed dentition with one permanent first molar erupted (Table 1). Almost the entire sample was composed of patients with Baume's deciduous dental arch type I (93.3%), being 8 patients from exposed group and 6 from non-exposed group. Only one patient from exposed group presented type II. Regarding relationship of canines, 66.7% of the whole sample presented Class I while the other 26.6% didn't have primary canines fully erupted and 6.7% had premature loss of canine. There was no statistical difference in the MTS of exposed group comparing T0 with T1 ($p = 0.938$) (Table 1). The space remained unchanged – without loss or gain of space.

The intra-rater reproducibility was good. This was evidenced by ICC values ranging from 0.73 to 1.00. Bland-Altman test showed that method agreement was adequate and there was no evidence of proportion bias, which means that no systematic error was detected in measurements (Table 2).

Considering dental arches, there was no statistical difference between the groups at the beginning of the study ($p > 0.05$) (Table 3). Regarding spatial changes in dental arches after the 24-month follow-up, results showed no statistical differences in the upper and lower arches of both exposed and non-exposed groups ($p > 0.05$) (Table 4).

Although there were no statistically significant differences in dental arches and occlusion development of infants and children with or without premature loss of primary anterior teeth, it is possible to observe physiological and pathological changes in dental arches and occlusion after 24 months follow-up through photographic recording and study models.

Through a qualitative analysis, it could be noticed that both the exposed group and the non-exposed group showed changes, including: primary teeth eruption and exfoliation; permanent teeth eruption; emergence of primary crowding; ectopic eruption of permanent first molars; self-correction of anterior open-bite; establishment of anterior open-bite, anterior and posterior cross-bite; premature loss of primary canines due to ectopic eruption of permanent lateral incisors; overbite increase; overbite decrease by the eruption of primary second molars; opening of MTS by the permanent successor eruption (Figure 1).

DISCUSSION

Supervising the eruption and development of primary and mixed dentition represents an essential component for the evolution of a permanent dentition with stable, functional and esthetic occlusion (McDonald, Avery and Dean, 2011). This supervision provides early detection of genetic and

environmental factors that may result in potential occlusion problems and future treatment needs (Mossey, 1999). Premature loss of primary teeth is a critical environmental factor identified during occlusion monitoring which can cause functional and morphological problems for dentition (Nadelman et al., 2021).

It is well known that there is an amount of space decrease after premature loss of primary posterior teeth (Tunison et al., 2008; Bughel et al., 2016; Kaklanos et al., 2016). However, there is a gap in the scientific literature about consequences of premature loss of primary anterior teeth on dental arches integrity (Nadelman et al., 2020). Hence, the present study aimed to evaluate dental arches and occlusion development of infants and children who have suffered premature loss of primary incisor(s) and/or canine(s), compared to infants and children without premature losses through a 24-month follow-up period.

Despite the lack of scientific evidence, there seems to be a consensus in dentistry, based on clinical experiences, that premature loss of primary anterior teeth would not require treatment, as it does not cause space loss (Holan and Needleman, 2014). In an attempt to support clinical decisions on scientific evidence, the present study provides preliminary results indicating that there are no space changes in dental arches after this premature loss. Taking into account the limitations of a small sample size, and the number of the drop outs due to the COVID-19 pandemic, current result agrees with the only classic clinical study published (Clinch and Healy, 1959), which found absence of space closure after premature loss of primary anterior teeth.

Considering possible causes for no space changes, it can be highlighted that between 3 and 6 years of age, primary dentition is generally stable, with no significant variations in individual tooth positioning or in the transverse and sagittal interarch relationships (Van der Linden, 1983). Since transversal dimensions of primary dental arches barely change from 3 to 6 years of age (Moorrees, 1959), it may have contributed to maintenance of arch dimensions.

On the other hand, transition from deciduous to permanent dentition extends over a prolonged period of child development from about 6 years of age with the mixed dentition, characterized by replacement of the dentition, facial growth, and dimensional changes of the dental arches (Garib et al., 2013). In this context, it is important to remember that at the study final evaluation, almost half of the sample was with complete deciduous dentition and the other half was in the first transitional period of mixed-dentition, characterized by the eruption of first permanent molars and/or exfoliation of primary incisors followed by eruption of permanent incisors. In addition, the potential for increased intracanine width and/or space of loss during eruption of the permanent incisor, as a compensatory mechanism, must be considered.

Even though there were no statistically significant differences in dental arches of infants and children either with or without premature loss of primary anterior teeth, regardless of the type of dentition, several changes could be observed in dental arches and occlusion of both groups during the monitoring period. Regarding the changes that could not be confirmed by statistical analysis the following can be emphasized: primary teeth eruption and

exfoliation; permanent teeth eruption; emergence of primary crowding; ectopic eruption of permanent first molars; self-correction of anterior open-bite; establishment of anterior open-bite, anterior and posterior cross-bite; premature loss of primary canines due to ectopic eruption of permanent lateral incisors; overbite increase; overbite decrease by the eruption of primary second molars; opening of MTS by the permanent successor eruption.

Furthermore, some dental arches didn't present notable clinical changes from the beginning to the end of the study, corroborating the theory (Moorrees, 1959; Van der Linden, 1983) that between complete deciduous dentition and the beginning of the mixed dentition, dental arches transverse dimensions remain stable, without significant clinical changes. It can be observed that occlusion development occurs in both groups in a similar way. Changes or maintenance of dental arch dimensions and occlusion progression happen regardless of exposure to premature loss of primary anterior teeth, and this corroborates the result presented in the statistics.

In addition, certain factors could increase the possibility of space loss, including Baume's deciduous dental arch type II, presence of non-nutritive habits, primary canines erupted at the loss moment, and amount of teeth lost (Nadelman et al., 2021). A greater possibility of space loss might be observed if there is no spacing (primate and generalized spaces) between the primary teeth or evidence of an arch-length inadequacy in the anterior region before tooth loss (McDonald, Avery and Dean, 2011). As most of the sample had Baume arch type I, and primary canines already erupted at the time of loss, the potential of space loss was smaller. In addition, presence of non-nutritive

habits was an exclusion criterion, and then it didn't influence dental arches' development. This fact also reduced significantly the sample size as the majority of infants have non-nutritive habits such as pacifier, thumb, or bottle sucking.

Regarding the number of teeth lost or extracted, White (1981) reported that consequences related to arch space loss are determined by the amount of incisors and canines lost. The author proposed that in the event of losing only one central incisor at a young age, significant alterations in the dental arch are unlikely to occur, except for a potential minor misalignment in the midline. If both central incisors are lost, it has been documented that there is no notable impact on the overall arch perimeter, but there is a chance that deleterious habits like tongue thrusting may develop. Once central and lateral incisors are prematurely lost, the potential consequences of acquiring deleterious oral habits may be more frequent, along with other outcomes such as extrusion of lower incisors to compensate for the lack of contact with opposing teeth.

Since space loss is usually minimal, unless the tooth or teeth are lost at a very young age, space maintenance after premature loss of primary anterior teeth is generally not necessary (Law, 2013). Besides that, if the tooth is lost at a very young age, the infant/child has neither primary second molars for anchorage of the space maintainer, nor sufficient maturity to receive an appliance (Silva-Filho and Garib, 2013). Therefore, literature suggests that space maintainer treatments should start at age 5 (Silva-Filho and Garib, 2013).

As noted, the main limitation of the study was the small sample size. It is worth mentioning that besides the suspension of subject recruitment and data collection for almost two years due to the COVID-19 pandemic, clinical measurement and arches' impression in infants are a challenge, since all of them present definitively negative behavior (Frankl et al., 1962), without cooperation to perform the clinical steps.

Concerning measurement instruments chosen for the study, digital caliper was selected for clinical evaluation of missing tooth/teeth space due to its high precision, fast reading and facility for statistical control (Toginho Filho et al., 2010). The only difficulty experienced during the clinical measurement was that infants/children showed fear of the sharp point of the digital caliper. It shows that pediatric dentist and orthodontist need to use behavior management techniques to measure space. In turn, study model measurements were performed in digital software since technology has become part of dental practice in which dental plaster models have been replaced by digital models to facilitate diagnosis and treatment planning (Çayönü et al., 2019). Besides that, digital measurements of primary dentition have apparently high accuracy level, comparable to direct measurement of plaster models (Kaihara et al., 2014).

CONCLUSION

The importance of statistical analysis in scientific research is undeniable. It is the science of collecting, exploring and presenting large amounts of data to discover underlying patterns and trends. Nevertheless, descriptive analysis complementary to statistics is also of utmost importance.

The present study concluded that there were no statistical differences over 24 months in dental arches and occlusion development of infants and children with premature loss of primary anterior teeth compared to infants and children without losses. However, physiological and pathological changes could be observed through clinical examination in both groups, which were not evidenced by statistical analysis. Therefore, periodic and long-term clinical follow-up of infants and children in dentition and occlusion development is suggested.

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TABLES

Table 1. Sample characteristics.

Characteristics	Exposed (n = 9)	Non exposed (n = 6)	Sample (n = 15)	P value
Group age, n (%)				
1	1 (11.1)	1 (16.7)	2 (13.3)	
2	2 (22.2)	2 (33.3)	4 (26.7)	
3	1 (11.1)	2 (33.3)	3 (20.0)	
4	4 (44.4)	1 (16.7)	5 (33.3)	
5	1 (11.1)	0 (0.0)	1 (6.7)	
Sex, n (%)				
Male	5 (55.6)	1 (16.7)	6 (40.0)	
Female	4 (44.4)	5 (83.3)	9 (60.0)	
Dentition, n (%)				
Incomplete deciduous	2 (22.2)	3 (50.0)	5 (33.3)	
Complete deciduous	6 (66.7)	3 (50.0)	9 (60.0)	
Mixed	1 (11.1)	0 (0.0)	1 (6.7)	
Baume's deciduous dental arch type, n (%)				
Type I	8 (88.9)	6 (100.0)	14 (93.3)	
Type II	1 (11.1)	0 (0.0)	1 (6.7)	
Relationship of canines, n (%)				
Class I	7 (77.7)	3 (50.0)	10 (66.7)	
Class II	0 (0.0)	0 (0.0)	0 (0.0)	
Class III	0 (0.0)	0 (0.0)	0 (0.0)	
Canines didn't fully erupted	1 (11.1)	3 (50.0)	4 (26.6)	
Loss of canine	1 (11.1)	0 (0.0)	1 (6.7)	
MTS measurement, mean dif (mm)	0.2	-	-	0.938

Table 2. Intra-rater repeatability calculated through ICC comparing T0 and T1 measurements and method precision evaluated through Bland-Altman test.

Measurement	ICC (95% CI)	Bland-Altman - Proportion bias Est (95% CI)
Intra-rater		
Space loss	0.99 (0.97, 1.00)	0.01 (-0.18, 0.20)
Upper arch perimeter	1.00 (0.99, 1.00)	-0.33 (-0.71, 0.04)
Upper arch width	0.99 (0.97, 1.00)	-0.10 (-0.36, 0.16)
Upper arch length	0.99 (0.98, 1.00)	0.20 (-0.10, 0.50)
Upper intercanine width	0.99 (0.96, 1.00)	0.12 (-0.04, 0.28)
Upper intercanine length	0.97 (0.90, 0.99)	0.12 (-0.10, 0.33)
Lower arch perimeter	1.00 (1.00, 1.00)	-0.20 (-0.40, 0.01)
Lower arch width	0.98 (0.94, 0.99)	-0.22 (-0.57, 0.12)
Lower arch length	0.83 (0.56, 0.94)	-0.23 (-1.59, 1.12)
Lower intercanine width	0.98 (0.93, 0.99)	0.09 (-0.07, 0.26)
Lower intercanine length	0.73 (0.34, 0.90)	-0.18 (-0.63, 0.27)

Table 3. Comparison between the exposed and non-exposed group for each dental linear measurement at T0 in order to verify if there was statistical difference between the groups at the beginning of the study.

Measurements (baseline), mm, mean ± SD	Exposed (n = 9)	Non exposed (n = 6)	*P*- value
Space loss	8.7 ± 2.2	---	---
Upper arch perimeter	73.3 ± 9.7	67.1 ± 11.6	0.282
Upper arch width	38.8 ± 3.5	36.9 ± 3.2	0.307
Upper arch length	22.6 ± 4.3	19.4 ± 4.5	0.190
Upper intercanine width	30.2 ± 1.9	29.7 ± 2.0	0.646
Upper intercanine length	9.0 ± 2.0	7.9 ± 0.9	0.233
Lower arch perimeter	65.4 ± 8.8	59.4 ± 12.5	0.293
Lower arch width	34.3 ± 2.7	32.2 ± 4.0	0.231
Lower arch length	19.2 ± 2.6	16.3 ± 4.9	0.226
Lower intercanine width	23.6 ± 1.4	22.5 ± 1.3	0.192
Lower intercanine length	4.9 ± 0.8	4.6 ± 1.2	0.546

* T-test, Shapiro-Wilk and Levene's test were used.

Table 4. Comparison of changes (T1-T0) in dental linear measurements of dental arches of exposed and non-exposed groups.

Measurements (T1-T0 change), mm, mean dif ± SD	Exposed (n = 9)	Non exposed (n = 6)	*P*- value
Space loss	1.1 ± 2.2	---	---
Upper arch perimeter	1.5 ± 1.6	0.1 ± 2.1	0.156
Upper arch width	1.6 ± 1.0	1.4 ± 1.0	0.672
Upper arch length	-0.4 ± 2.2	-0.6 ± 1.0	0.886
Upper intercanine width	1.5 ± 1.2	0.7 ± 1.6	0.342
Upper intercanine length	-0.1 ± 1.3	0.0 ± 1.0	0.857
Lower arch perimeter	0.8 ± 1.9	0.7 ± 2.5	0.915
Lower arch width	1.2 ± 0.8	1.3 ± 1.2	0.860
Lower arch length	1.1 ± 3.4	0.7 ± 0.9	0.790
Lower intercanine width	1.0 ± 1.0	0.5 ± 1.2	0.429
Lower intercanine length	1.1 ± 0.7	0.8 ± 0.4	0.334

* T-test, Shapiro-Wilk and Levene's test were used.

Figure1. Photographs and digital models of patients from exposed and unexposed group at T0 and T1 to illustrate changes occurred after 24 months. A1, B1, C1, D1, E1, F1, G1, H1 and I1 – Intraoral photograph from T0; A2, B2, C2, D2, E2, F2, G2 – Digital models from T0; A3 and A4 – intraoral photograph and digital models from T1 demonstrating overbite decrease by the eruption of primary upper second molars (55 and 65); B3 and B4 – intraoral photograph and digital models from T1 showing overbite increase; C3 and C4 – intraoral photograph and digital models from T1 showing primary teeth (51, 61, 71 and 81) exfoliated and permanent teeth (11, 31 and 41) eruption; D3 and D4 – intraoral photograph and digital models from T1 presenting

premature loss of lower primary canines (73 and 83) due to ectopic eruption of permanent lateral incisors (32 and 42); E3 and E4 – intraoral photograph and digital models from T1 presenting self-correction of anterior open-bite; F3 and F4 – intraoral photograph and digital models from T1 showing primary crowding in lower permanent incisors (31, 32, 41 and 42), opening of MTS by the initiating of permanent successor eruption (11 and 21), and ectopic eruption of permanent first molar (26); G3 and 4 – intraoral photograph and digital models from T1 presenting especially primary crowding, establishment of anterior cross-bite, and lack of space for eruption of permanent teeth; H2 – establishment of posterior cross-bite and primary teeth eruption.

5 CONSIDERAÇÕES FINAIS

Na presente tese, por meio de uma revisão sistemática e meta-análise concluímos que a perda precoce de dentes decíduos anteriores pode causar distorção da fala com baixa certeza de evidência. A realização de uma meta-análise avaliando a perda de espaço após essa perda precoce não foi possível, deixando uma lacuna sobre as possíveis consequências morfológicas da perda de incisivos e caninos decíduos.

Na sequência, realizamos a revisão crítica da literatura, a fim de compilar os dados científicos disponíveis na literatura sobre etiologia, características da perda de incisivos e da perda de caninos decíduos, diagnóstico, consequências morfológicas, funcionais e psicossociais da perda precoce anterior e discussão sobre a necessidade de intervir e quais as possíveis intervenções.

O desenvolvimento do e-book sobre a perda precoce de dentes decíduos anteriores baseado em revisões de literatura, revisões sistemáticas e meta-análises e estudos clínicos, teve por objetivo disponibilizar o conhecimento mais atualizado sobre o tema para alunos de Odontologia, cirurgiões-dentistas recém formados e clínicos, destacando as evidências científicas disponíveis na literatura de forma rápida, direta e dinâmica, com fácil portabilidade e leitura em qualquer lugar, inclusive pela tela do celular.

Com base nos resultados alcançados no estudo de concordância e reprodutibilidade comparando a realização de medidas dentárias lineares em modelo de gesso com paquímetro digital e compasso de pontas secas e digitalmente nos modelos de estudo escaneados, podemos destacar que a análise de modelos com dentição decídua com e sem a perda de dentes decíduos anteriores pode ser realizada com todos os instrumentos com boa concordância e reprodutibilidade. Esse resultado possibilita a autonomia do cirurgião dentista no momento de escolher o instrumento à ser utilizado. Vale destacar que, a mensuração em modelos digitalizados apresenta uma etapa adicional em comparação à mensuração em modelos físicos: a digitalização dos modelos. Nesse sentido, novos estudos comparando instrumentos para mensuração em modelos de gesso com mensuração digital após

escaneamento das arcadas diretamente na cavidade bucal com scanner intrabucal, poderiam ser desenvolvidos.

Diante dos resultados obtidos no estudo de concordância e reprodutibilidade comparando paquímetro digital e compasso de pontas secas para a mensuração do espaço do dente anterior perdido, nota-se que ambos os instrumentos podem ser utilizados com excelente concordância e reprodutibilidade para mensurações clínicas do espaço da perda precoce anterior. Destaca-se que, este estudo apresentou a limitação de não ser possível realizar a análise intraexaminador, visto que, poderia haver perda de espaço no espaço do dente perdido após o intervalo necessário para repetição das mensurações.

A partir do estudo observacional de coorte, pode-se observar que não houve diferenças estatísticas nos arcos dentários e desenvolvimento da oclusão de bebês e crianças com perda precoce de dentes decíduos anteriores em comparação com bebês e crianças sem perdas. Devemos levar em consideração as limitações de uma amostra pequena e, por isso, sugerimos que novos estudos sejam desenvolvidos para que seja determinado, em definitivo, as consequências morfológicas da perda precoce de dentes decíduos anteriores.

Por outro lado, alterações fisiológicas e patológicas foram diagnosticadas nos bebês e crianças dos dois grupos após o acompanhamento contínuo dos mesmos, por meio da avaliação clínica, fotográfica e por modelos de estudo desses indivíduos, demonstrando a relevância da análise descritiva do estudo.

Vale ressaltar que, a evolução das dentições é um processo contínuo que acontece a longo prazo e é caracterizado pela ocorrência de eventos riquíssimos para o desenvolvimento da oclusão. Por isso, percebemos que o acompanhamento clínico de bebês e crianças com ou sem a perda precoce de dentes decíduos anteriores é de extrema importância. O reconhecimento de alterações fisiológicas da dentição em suas diferentes fases e o diagnóstico precoce de alterações patológicas com desvio da normalidade, permitem a orientação para o desenvolvimento de uma oclusão estável e harmônica.

6 CONCLUSÕES

Com base nos resultados apresentados, o presente estudo concluiu que não houve alterações estatisticamente significativas nos arcos dentários e desenvolvimento da oclusão de bebês e crianças com perda precoce de dentes decíduos anteriores em comparação com bebês e crianças sem perdas. No entanto, alterações fisiológicas e patológicas foram evidenciadas tanto no grupo exposto quanto no grupo não-exposto pela avaliação visual tanto no exame clínico, fotográfico e de modelos de estudo dos participantes. Dentre essas alterações, pode-se ressaltar: diminuição de sobremordida acentuada, erupção e esfoliação de dentes decíduos, erupção de dentes permanentes, perda precoce de caninos pela erupção ectópica dos incisivos laterais, autocorreção de mordida aberta anterior, estabelecimento de mordida cruzada posterior, apinhamento ântero-inferior, erupção ectópica de primeiro molar permanente, entre outros. Por isso, sugere-se o acompanhamento clínico dos bebês e crianças, uma vez que, essas alterações não foram diagnosticadas pela análise estatística, mas foram evidenciadas clinicamente.

No que tange às demais proposições, considerando a 1ª fase do estudo:

6.1 A revisão sistemática e meta-análise concluiu que a perda precoce de dentes decíduos anteriores afeta a fonação de crianças, causando distorção da fala.

6.2 A revisão crítica da literatura apresentou e discutiu todas as evidências cientificas disponíveis na literatura sobre etiologia, características, diagnóstico, consequências e intervenção da perda precoce de dentes decíduos anteriores.

6.3 E-book foi desenvolvido e encontra-se disponível para guiar alunos de Odontologia, cirurgiões-dentistas recém-formados e clínicos de forma simples e prática quanto às evidências cientificas disponíveis na literatura sobre a perda precoce de dentes decíduos anteriores.

Com base nos resultados da 2ª fase do estudo, conclui-se que:

6.4 Mensurações realizadas em modelos digitais obtidos por escaneamento de modelos de gesso apresentaram uma excelente reprodutibilidade e bom concordância quando comparados com medidas

realizadas diretamente sobre os modelos com paquímetro digital e compasso de pontas secas.

6.5 Paquímetro digital e compasso de pontas secas são instrumentos eficazes para medir o espaço da perda precoce de dentes decíduos anteriores diretamente na cavidade bucal do bebê/criança e podem ser aplicados com elevada concordância e reprodutibilidade.

A partir da 3ª fase do estudo, observou-se que:

6.6 Não houve alterações estatisticamente significativas nos arcos dentários e desenvolvimento da oclusão de bebês e crianças com perda precoce de dentes decíduos anteriores em comparação com bebês e crianças sem perdas. No entanto, alterações fisiológicas e patológicas foram diagnosticadas tanto nos bebês e crianças do grupo exposto quanto não-exposto por meio avaliação clínica desses indivíduos, demonstrando a importância da pela análise descritiva do estudo.

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APÊNDICES

APÊNDICE A – Termo de Consentimento Livre e Esclarecido.

Faculdade de Odontologia da Universidade Federal do Rio de Janeiro
Departamento de Odontopediatria e Ortodontia
Disciplina de Odontopediatria

TERMO DE CONSENTIMENTO INFORMADO LIVRE E ESCLARECIDO

"Efeitos da perda/extração precoce de dente(s) decíduo(s) anterior(es) no perímetro do arco e no padrão da fala"

Prezado responsável,

O Sr (a) está sendo convidado (a) a participar deste projeto de pesquisa na Universidade Federal do Rio de Janeiro, sob-responsabilidade da pesquisadora doutoranda **PATRICIA NADELMAN.**

Por favor, leia este termo cuidadosamente, pois, as informações a seguir irão descrever esta pesquisa e sua função nela como participante. Caso tenha qualquer dúvida sobre este estudo ou termo, você deverá esclarecê-la com a pesquisadora responsável pelo trabalho.

Justificativa e objetivos: Muitas crianças batem os dentes; muitas crianças apresentam cárie (doença do dente) em estágio avançado e esse dois motivos podem resultar na perda ou extração (retirada) dos dentes decíduos anteriores ("dentes de leite da frente"). Essa perda do dente sem colocação de um aparelho que mantenha o espaço pode causar problemas para a criança; para sua qualidade de vida; e para a erupção ("nascimento") de seus dentes permanentes (de adulto). Essa pesquisa que você está sendo convidado a participar quer avaliar quais são os efeitos dessa perda de dentes decíduos anteriores ("dentes de leite da frente") sem tratamento. Além disso, queremos avaliar se a presença do canino decíduo ("de leite") influencia na diminuição dessas consequências.

Descrição do estudo: Para realização desta pesquisa serão selecionados bebês/crianças, com idade entre 0 e 48 meses, apresentando ausência ou necessidade de extração (retirada) de pelo menos 1 dente de leite e da frente. Os bebês/crianças serão selecionadas para o estudo e serão acompanhadas. Todos os participantes passarão por um exame, terão seus dentes fotografados (rostos não serão fotografados, apenas os dentes), radiografados (RX) e moldados (uma massa será usada para criar uma cópia do dente do menor que está sob sua responsabilidade) na consulta inicial. Os bebês/crianças não receberão qualquer tipo de tratamento com aparelhos. Os participantes serão acompanhadas por consultas que ocorrem

imediatamente após, uma semana após, duas semanas após, um mês após, três meses após, seis meses após e doze meses após a perda ou extração (retirada) do dente de leite. Os bebês/crianças continuarão matriculadas no departamento e serão acompanhadas por outros profissionais de uma das clínicas de Odontopediatria.

Riscos: Como o bebê/criança não receberá tratamento com aparelho para manutenção de espaço, podem ocorrer problemas como: desvio de linha média; impactação (não nasce) ou erupção tardia (nasce mais tarde) do dente sucessor permanente; diminuição do perímetro do arco (espaço na boca); extrusão (dente sai um pouco para fora) e/ou inclinação de outros dentes; apinhamento ("encavalamento"); problemas na fala e na estética. Se isso ocorrer, o participante receberá o tratamento adequado, ao final do acompanhamento da pesquisa. Além disso, se o bebê/criança ou responsável sentir qualquer desconforto, deve nos procurar na clínica. Quanto ao risco do raio-x (RX), todos os participantes e seus responsáveis (caso sejam solicitados durante o exame), serão protegidos com aventais e colares de chumbo. Vale avisar, que o exame de RX no início do tratamento e de acompanhamento são realizados em todas as crianças normalmente atendidas nas clínicas de Odontopediatria do Departamento de Odontopediatria e Ortodontia da UFRJ para possibilitar um correto plano de tratamento.

Benefícios: Ao ser voluntário, além de estar contribuindo com a pesquisa, o Sr(a) receberá maiores informações sobre cuidados com a saúde bucal do menor que está sob sua responsabilidade. Os bebês/crianças que necessitarem qualquer outro tipo de tratamento dentário terão a oportunidade de receber tratamento na clínica de Odontopediatria da FO-UFRJ. Todos os participantes receberão orientações de higiene bucal. Bebês/crianças com outros problemas bucais serão encaminhadas para triagem e tratamento na FO-UFRJ.

Garantia de acesso aos pesquisadores: Em qualquer fase do estudo você terá pleno acesso a pesquisadora responsável, doutoranda **PATRICIA NADELMAN**, no Departamento de Odontopediatria e Ortodontia da Faculdade de Odontologia/UFRJ (Av. Prof Paulo Rocco, 325; 2° andar; Cidade Universitária, Rio de Janeiro) de segunda à sexta-feira das 09:00h às 16:00h, ou pelos telefones: (21) 39382043, 39382095 ou **992033260 (24 horas)**.

Garantia de liberdade: A participação neste estudo é absolutamente voluntária. Você está livre para, a qualquer momento, negar o consentimento ou desistir de participar e retirar o consentimento, sem que isto traga qualquer tipo de dano ou impedimento. Lembramos, assim, que a recusa não trará nenhum prejuízo à relação com o pesquisador ou com a instituição e que a participação não é obrigatória.

Direito de confidencialidade e acessibilidade: os dados colhidos no presente estudo serão utilizados para elaborar artigos científicos. Porém, todas as informações obtidas através dessa pesquisa serão confidenciais e asseguramos o absoluto sigilo dos que aceitarem participar. Os dados não serão divulgados de forma a possibilitar a identificação do participante e ninguém, com exceção dos próprios pesquisadores, poderá ter acesso aos resultados da pesquisa. Cada participante somente poderá ter acesso aos próprios resultados. É assegurado o completo sigilo da identidade do

participante quanto à participação neste estudo, incluindo a eventualidade da apresentação dos resultados deste estudo em congressos e periódicos científicos.

Despesas e compensações: o participante não terá, em momento algum, despesas financeiras pessoais. As despesas, assim, se por ventura ocorrerem, serão de responsabilidade dos próprios pesquisadores. Também, não haverá compensação financeira relacionada à participação nesta pesquisa. A participação nesta pesquisa não gera custos e a extração do dente na Instituição, e cedido pelo participante, é gratuita.

Garantia de indenização: Em caso de eventuais danos pessoais, causados por danos comprovadamente ligados a participação neste estudo, o participante terá direito aos tratamentos dentário e médico na Instituição, bem como às indenizações legalmente estabelecidas.

Caso surja alguma dúvida quanto à ética do estudo, o (a) Sr. (a) deverá entrar em contato com o Comitê de Ética em Pesquisas envolvendo seres humanos – subordinado ao Conselho Nacional de Ética em Pesquisa, órgão do Ministério da Saúde, através de solicitação ao representante de pesquisa, que estará sob contato permanente, ou contatando o Comitê de Ética em Pesquisa do Hospital Universitário Clementino Fraga Filho/HUCFF/UFRJ – R. Prof. Rodolpho Paulo Rocco, n.°255 – Cidade Universitária/Ilha do Fundão - 7° andar – ALA E, pelo telefone 3938-2480, de segunda a sexta-feira, das 8 às 16 horas, ou através do e-mail: cep@hucff.ufrj.br. **O Comitê de Ética em Pesquisa é um órgão que controla as questões éticas das pesquisas na instituição e tem como uma das principais funções proteger os participantes da pesquisa de qualquer problema.**

Eu receberei uma via desse Termo de Consentimento Livre e Esclarecido (TCLE) e a outra ficará com a pesquisadora responsável por essa pesquisa. Além disso, estou ciente de que eu e a pesquisadora responsável deveremos rubricar todas as folhas das duas vias desse TCLE e assinar na última folha.

Li e concordo em participar do estudo,

Nome do participante de pesquisa	Patricia Nadelman Pesquisadora Responsável
Assinatura do participante de pesquisa	

Rio de Janeiro,
____/_____/_____

APÊNDICE B – Ficha clínica dos participantes da pesquisa.

				Data do atendimento: /_____/_____
Nome da Criança:			**Nascimento: / /**	**Idade atual:**
Nome do acompanhante:			**Idade:**	**Escolaridade:**
O acompanhante possui parentesco com a criança?	☐ **Não** ☐ **Sim**	**Qual?**		
Endereço:				
Bairro:		**Cidade:**		**CEP:**
Telefone residencial:	**Telefone do trabalho:**			**Celular**

Qual (ais) o(s) motivo (s) ou queixa (s) para a procura por atendimento?		
☐ Dor	☐ Estética	☐ Dificuldade na alimentação
☐ Dificuldade na fala	☐ Dificuldade na socialização	☐ Alteração de cor
☐ Dificuldade de higienização	☐ Mobilidade dentária	☐ Edema
☐ Outra – qual?		

ANAMNESE					
Cor:	☐ Branca	☐ Parda	☐ Negra		
Acompanhamento médico:	☐ Posto de Saúde	☐ Hospital Público	☐ IPPMG	☐ Clínica Particular	
Está em tratamento médico atualmente?	☐ Não	☐ Sim	Qual?		
Está utilizando algum medicamento no momento?	☐ Não	☐ Sim			
Já esteve hospitalizado?	☐ Não	☐ Sim	Motivo:		
Já recebeu transfusão sanguínea:	☐ Não	☐ Sim			
Já recebeu ou recebe algum(ns) dos seguintes tratamentos?					
☐ Cardíaco	☐ Sanguíneo	☐ Hepático	☐ Endócrino	☐ Renal	
☐ Psicológico	☐ Gastro- intestinal	☐ Dermatológico	☐ Ortopédico	☐ Oftalmológico	
☐ Otorrinolaringológico	☐ Neurológico	☐ Respiratório			
Possui cobertura antitetânica?	☐ Não	☐ Sim			

EXAME CLÍNICO				
TECIDOS MOLES				
Lábios:	☐ Normais	☐ Superior curto	☐ Inferior evertido	☐ Lesão – Tipo:
Mucosa jugal:	☐ Normal	☐ Lesão – Tipo:		
Língua:	☐ Normal	☐ Lesão – Tipo:		
Palato:	☐ Normal	☐ Profundo	☐ Lesão – Tipo:	
Soalho bucal:	☐ Normal	☐ Lesão – Tipo:		
Gengiva:	☐ Normal	☐ Gengivite	☐ Retração gengival	☐ Abscesso gengival
	☐ Fístula gengival		☐ Outros	
OCLUSÃO				
Dentição:	☐ Decídua incompleta		☐ Decídua completa	
Relação canino:	**Direita**	☐ Classe I	☐ Classe II	☐ Classe III
	Esquerda	☐ Classe I	☐ Classe II	☐ Classe III

Tipo de arco decíduo:	**Superior**	☐ Tipo I de Baume		☐ Tipo II de Baume
	Inferior	☐ Tipo I de Baume		☐ Tipo II de Baume
Mordida aberta:	☐ Sim	☐ Não		
Sobremordida:	☐ Normal	☐ Moderada	☐ Acentuada	
Sobressaliência:	☐ Normal	☐ Moderada	☐ Acentuada	
Mordida cruzada:	☐ Não	☐ Anterior	☐ Posterior direita	☐ Posterior esquerda
	☐ Total – Elementos envolvidos			
Apinhamento:	☐ Não	☐ Superior	☐ Inferior	☐ Ambos
Vedamento labial:	☐ Adequado	☐ Inadequado		
Hábitos orais:	☐ Não	☐ Sim		☐ Sucção de dedo
	☐ Roer unhas	☐ Sucção de mamadeira		☐ Sucção de chupeta
	☐ Outros			
Registre observações que julgar importantes:				

HIGIENE ORAL			
Biofilme visível:	☐ Sim	☐ Não	Elementos envolvidos:
Cálculo:	☐ Sim	☐ Não	Elementos envolvidos:
Sangramento gengival:	☐ Sim	☐ Não	Elementos envolvidos:

EM CASOS DE TRAUMA:						
História do Trauma:						
Quando ocorreu o trauma?						
Qual foi o primeiro socorro prestado pelo responsável?						
Onde ocorreu trauma:	☐ Rua	☐ Casa	☐ Escola	☐ Igreja	☐ Piscina	☐ Parque
	☐ Outros					
Como ocorreu trauma?	☐ Queda da própria altura		☐ Outra queda - qual?			
	☐ Agressão física		☐ Acidente ciclístico			
	☐ Acidente automobilístico		☐ Acidente esportivo			
	☐ Cabeçada		☐ Outros:			
Qual foi a injuria sofrida?						
Há alguma sequela? Qual?						
O dente foi extraído? Por qual motivo?						

Após o exame, marcar um X no(s) dente(s) perdido(s) ou extraído(s):									
55	**54**	**53**	**52**	**51**	**61**	**62**	**63**	**64**	**65**
85	**84**	**83**	**81**	**71**	**72**	**73**	**74**	**74**	**75**

Registre observações que julgar importantes:

Dentes									
Diagnóstico									

PLANO DE TRATAMENTO		
	Dente	**Tratamento**
1		
2		
3		
4		
5		
6		

Data	Dente/Região	Trabalho Realizado	H	C	Aluno	Professor

ANEXOS

ANEXO A – Parecer consubstanciado do CEP – versão 1.

UFRJ - HOSPITAL UNIVERSITÁRIO CLEMENTINO FRAGA FILHO DA

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Efeitos da perda de dentes de leite da frente na arcada dentária e no padrão da fala.

Pesquisador: PATRICIA NADELMAN
Área Temática:
Versão: 1
CAAE: 02502818.7.0000.5257
Instituição Proponente: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO
Patrocinador Principal: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

DADOS DO PARECER

Número do Parecer: 3.093.819

Apresentação do Projeto:
Protocolo 370-18, do grupo III, recebido em 7.11.2018.

Introdução: A dentição decídua apresenta fundamental importância funcional, psicossocial e morfológica para a criança, auxiliando no crescimento e desenvolvimento adequado dos ossos e musculatura facial, mastigação, fonação e estética (BROTHWELL, 1997). Além disso, a manutenção da integridade dos arcos dentários decíduos constitui fator que exerce forte influência no desenvolvimento da dentição permanente, mantendo o comprimento dos arcos e preservando espaço para erupção dos dentes sucessores (THUROW, 1977).A perda ou extração prematura de dentes decíduos é considerada um problema de saúde bucal, tanto pelo seu aspecto psicológico, quanto pelo dano funcional. A perda precoce é definida como a ausência de um dente temporário enquanto o sucessor permanente ainda não se encontra em estágio de erupção, e por este motivo, não pode ser palpado ao exame clínico (PEDERSEN; STENSGAARD; MELSEN, 1978). Pode acometer tanto a região anterior quanto a posterior. A
etiologia mais comum da perda precoce de decíduos posteriores está associada à cárie dentária (BROTHWELL, 1997; NGAN; ALKIRE; FIELDS, 1999). Enquanto que, a perda prematura de dentes anteriores ocorre em circunstâncias como trauma, cárie avançada ou extração de um dente neonatal (MCDONALD & AVERY, 2011; MALMGREN et al., 2012).Esta perda dentária anterior

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Continuação do Parecer: 3.093.819

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Outros	termo_de_compromisso_do_pesquisador_assinado.pdf	29/10/2018 15:12:03	PATRICIA NADELMAN	Aceito
Outros	anexo.doc	29/10/2018 15:11:47	PATRICIA NADELMAN	Aceito
Outros	termo_de_comprimisso_do_pesquisador_em_branco.doc	29/10/2018 15:07:28	PATRICIA NADELMAN	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.doc	29/10/2018 15:06:42	PATRICIA NADELMAN	Aceito
Projeto Detalhado / Brochura Investigador	projeto_de_pesquisa_detalhado.doc	29/10/2018 15:06:32	PATRICIA NADELMAN	Aceito
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Cronograma	cronograma.doc	29/10/2018 15:00:45	PATRICIA NADELMAN	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

RIO DE JANEIRO, 19 de Dezembro de 2018

Assinado por:
Carlos Alberto Guimarães
(Coordenador(a))

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ANEXO B – Parecer consubstanciado do CEP – versão 2.

UFRJ - HOSPITAL UNIVERSITÁRIO CLEMENTINO FRAGA FILHO DA UNIVERSIDADE FEDERAL DO RIO DE JANEIRO / HUCFF-UFRJ

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: Efeitos da perda de dentes de leite da frente na arcada dentária e no padrão da fala.

Pesquisador: PATRICIA NADELMAN
Área Temática:
Versão: 2
CAAE: 02502818.7.0000.5257
Instituição Proponente: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO
Patrocinador Principal: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

DADOS DO PARECER

Número do Parecer: 4.609.804

Apresentação do Projeto:
Protocolo 370-18. Emenda E1 recebida em 21/01/2021.

As informações colocadas nos campos denominados "Apresentação do Projeto", "Objetivo da Pesquisa" e "Avaliação dos Riscos e Benefícios" foram retiradas do arquivo intitulado "PB_INFORMAÇÕES_BÁSICAS_1692337_E1.pdf", postado em 21/01/2021.

Introdução

A dentição decídua apresenta fundamental importância funcional, psicossocial e morfológica para a criança, auxiliando no crescimento e desenvolvimento adequado dos ossos e musculatura facial, mastigação, fonação e estética (BROTHWELL, 1997). Além disso, a manutenção da integridade dos arcos dentários decíduos constitui fator que exerce forte influência no desenvolvimento da dentição permanente, mantendo o comprimento dos arcos e preservando espaço para erupção dos dentes sucessores (THUROW, 1977).A perda ou extração prematura de dentes decíduos é considerada um problema de saúde bucal, tanto pelo seu aspecto psicológico, quanto pelo dano

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Continuação do Parecer: 4.609.804

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Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

RIO DE JANEIRO, 24 de Março de 2021

Assinado por:
Carlos Alberto Guimarães
(Coordenador(a))

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ANEXO C – Parecer consubstanciado do CEP – versão 3.

UFRJ - HOSPITAL UNIVERSITÁRIO CLEMENTINO FRAGA FILHO DA UNIVERSIDADE FEDERAL DO RIO DE JANEIRO / HUCFF-UFRJ

PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: Efeitos da perda de dentes de leite da frente na arcada dentária e no padrão da fala.

Pesquisador: PATRICIA NADELMAN
Área Temática:
Versão: 3
CAAE: 02502818.7.0000.5257
Instituição Proponente: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO
Patrocinador Principal: UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

DADOS DO PARECER

Número do Parecer: 5.621.927

Apresentação do Projeto:
As informações elencadas nos campos intitulados "Apresentação do Projeto", "Objetivo da Pesquisa" e "Avaliação dos Riscos e Benefícios" foram retiradas do arquivo intitulado PB_INFORMAÇÕES_BÁSICAS_1988979_E2.pdf, postado em 26/07/2022.

Introdução:
A dentição decídua apresenta fundamental importância funcional, psicossocial e morfológica para a criança, auxiliando no crescimento e desenvolvimento adequado dos ossos e musculatura facial, mastigação, fonação e estética (BROTHWELL, 1997). Além disso, a manutenção da integridade dos arcos dentários decíduos constitui fator que exerce forte influência no desenvolvimento da dentição permanente, mantendo o comprimento dos arcos e preservando espaço para erupção dos dentes sucessores (THUROW, 1977).A perda ou extração prematura de dentes decíduos é considerada um problema de saúde bucal, tanto pelo seu aspecto psicológico, quanto pelo dano funcional. A perda precoce é definida como a ausência de um dente temporário enquanto o sucessor permanente ainda não se encontra em estágio de erupção, e por este motivo, não pode ser palpado ao exame clínico (PEDERSEN; STENSGAARD; MELSEN, 1978). Pode acometer tanto a

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Continuação do Parecer: 5.621.927

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Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

RIO DE JANEIRO, 02 de Setembro de 2022

Assinado por:
Monique Loureiro
(Coordenador(a))

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