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VANESSA PACHECO DE OLIVEIRA MOTA

DETECÇÃO DE DESAJUSTES NA INTERFACE *ABUTMENT*-PRÓTESE: IMPLICAÇÕES DA TÉCNICA RADIOGRÁFICA E DA MAGNITUDE DO DESAJUSTE NA REGIÃO ESTÉTICA

VITÓRIA
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Dissertação apresentada ao Programa de Pós-Graduação em Ciências Odontológicas da Universidade Federal do Espírito Santo, como requisito parcial para obtenção do título de Mestre em Ciências Odontológicas, sob orientação do Prof. Dr. Sergio Lins de Azevedo Vaz.

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RESUMO

Desajustes na interface *abutment*-prótese representam um contratempo no tratamento reabilitador com implantes dentários. As radiografias periapicais são utilizadas como método auxiliar para a avaliação de desajustes na interface *abutment*-prótese, entretanto, as evidências que suportam o uso desse método de diagnóstico são restritas a estudos de baixa a moderada qualidade. O objetivo, neste estudo *in vitro*, foi comparar a acurácia de 3 técnicas radiográficas periapicais na detecção de desajustes na interface *abutment*-prótese em região estética e avaliar se a magnitude do desajuste influencia no diagnóstico. Para isso, 15 implantes com conexão cônica interna foram instalados na região de incisivo central em maxilas de poliamida e copings para coroas cimentadas personalizados foram confeccionados em cerâmica por meio de sistema CAD/CAM. Desajustes de 50, 100 e 150 μm foram simulados por meio da interposição de 1, 2 ou 3 tiras de poliéster de 50 μm de espessura, respectivamente, posicionada(s) na interface *abutment*-prótese; a ausência da tira representou o grupo controle. Radiografias digitais foram obtidas utilizando-se posicionadores para as seguintes técnicas periapicais: bissetriz (PTB), paralelismo (PTP) e paralelismo modificado (PTM). Um total de 180 radiografias digitais foi avaliado por 2 radiologistas e 1 protesista. Os valores de área sob curva característica de operação do receptor (Az) foram submetidos ao teste de Friedman com *post-hoc* de Durbin-Conover ($\alpha = 5\%$). Diferenças estatisticamente significantes foram encontradas ($\chi^2 = 22.0$; $p < 0,05$). Observou-se diferença estatística ($p < 0.05$) entre a as técnicas PTP (Az = 0.873) e PTB (Az = 0.753) para magnitude 50 μm, sendo a PTP mais acurada. Magnitudes maiores apresentaram maior acurácia em relação às magnitudes menores ($p < 0.05$). Nas interações técnica e magnitude, todas as comparações tiveram diferenças estatísticas ($p < 0.05$), exceto para PTP magnitude 100 μm (Az = 0.976) e a PTM magnitude 150 μm (Az = 0.998). Concluiu-se que a PTP foi mais acurada do que a PTB para detectar desajustes de 50 μm na interface *abutment*-prótese e que desajustes maiores resultaram em diagnósticos mais acurados independentemente da técnica utilizada.

Palavras-chave: radiografia dentária digital, implante dentário, prótese dentária.

ABSTRACT

Misfits in the abutment-prosthesis interface represent a setback in the rehabilitation treatment with dental implants. Periapical radiographs are used as an auxiliary method for assessing misfits at the abutment-prosthesis interface; however, the evidence supporting the use of this diagnostic method is restricted to studies of low to moderate quality. The aim of this in vitro study was to compare the accuracy of 3 periapical radiographic techniques in detecting misfits at the abutment-prosthesis interface in the esthetic region and to assess whether the magnitude of the misfit influences the diagnosis. For this, 15 implants with an internal conical connection were installed in the central incisor region in polyamide maxillae and copings for customized cemented crowns were made in ceramic using a CAD/CAM system. Misfits of 50, 100 and 150 µm were simulated by interposing 1, 2 or 3 polyester strips of 50 µm thickness, respectively, positioned at the abutment-prosthesis interface; the absence of the strip represented the control group. Digital radiographs were obtained using positioners for the following periapical techniques: bisecting (PTB), parallelism (PTP) and modified parallelism (PTM). A total of 180 digital radiographs were evaluated by 2 radiologists and 1 prosthodontist. The values of the area under the receiver operating characteristic curve (Az) were submitted to the Friedman test with post-hoc Durbin-Conover ($\alpha = 5\%$). Statistically significant differences were found ($\chi^2 = 22.0$; $p < 0.05$). There was a statistical difference ($p < 0.05$) between the PTP (Az = 0.873) and PTB (Az = 0.753) techniques for magnitude 50 µm, with the PTP being more accurate. Larger magnitudes showed greater accuracy compared to smaller magnitudes ($p < 0.05$). In the technical and magnitude interactions, all comparisons had statistical differences ($p < 0.05$), except for PTP magnitude 100 µm (Az = 0.976) and PTM magnitude 150 µm (Az = 0.998). It was concluded that PTP was more accurate than PTB to detect misfits of 50 µm at the abutment-prosthesis interface and that larger misfits resulted in more accurate diagnoses regardless of the technique used.

Keywords: Dental radiography, dental implant, dental prosthesis.

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LISTA DE ABREVIATURAS, SIGLAS E SÍMBOLOS

kVp Kilovolts – pico

mA Miliamperes

MEV Microscópio Eletrônico de Varredura

N Newton

ROC Receiver Operating Characteristics

UFES Universidade Federal do Espírito Santo

μm Micrômetro

SUMÁRIO

1 INTRODUÇÃO GERAL

A substituição de um elemento dentário por implantes osseointegrados representa uma importante alternativa para pacientes parcial ou totalmente desdentados devido à sua alta taxa de sucesso a longo prazo, embora problemas possam ocorrer (CHEE; JIVRAJ, 2006; MEI et al., 2017; SCARANO et al., 2016). A presença de desajustes na interface *abutment*-prótese, por exemplo, configura um problema para o tratamento reabilitador (CALDERON et al., 2014; CHEN et al., 2013; SANTOS et al,2007; JEMT, 1991).

As próteses sobre implantes podem ser fixadas aos *abutments* por meio de parafusos ou da cimentação e a interface *abutment*-prótese é uma região importante de ser observada (CHEE; JIVRAJ, 2006; KIM; LEE, 2020; HONG et al., 2020). Na literatura, ainda não há consenso sobre qual método de retenção desempenha melhores resultados, todavia, retenções cimentadas são indicadas em regiões estéticas quando retenções parafusadas forem visíveis (LEE; OKAYASU; WANG, 2010; SHADID; SADAQA, 2012). Contudo, retenções cimentadas apresentam limitações devido à dificuldade de remoção do excesso de cimento e, com isso, podem favorecer o desenvolvimento de mucosite peri-implantar e peri-implantite (SAILER et al., 2012; LEE; OKAYASU; WANG, 2010).

Wilson (2009) observou que o excesso de cimento dentário esteve associado a 81% de implantes com sinais de peri-implantite. Estudos in vitro demonstraram dificuldade na remoção de cimento e no controle por meios visuais e táteis, sendo a radiografia um meio de avaliação não invasivo que permite detectar o excesso ou a falta de cimentação (LINKEVICIUS et al., 2011; WADHWANI et al., 2012). Entretanto, Piattelli et al. (2001) compararam a penetração bacteriana e de fluidos na interface implante-*abutment* em próteses cimentadas e parafusadas e observaram que, nas retenções cimentadas, não foi constatada a penetração de bactérias e de fluidos na porção interna dos implantes. Ainda que uma tolerância biológica de 100 µm ao desajuste seja aceita para o ajuste passivo, principalmente em retenções cimentadas (LEE; OKAYASU; WANG, 2010; JEMT; BOOK, 1996), a presença de desajustes na interface *abutment*-prótese representa um contratempo (CALDERON et al., 2014; CHEN et al., 2013; SANTOS et al,2007; JEMT, 1991). Chen et al. (2013) observaram que desajustes em próteses cimentadas resultaram em maior perda óssea em comparação com próteses ajustadas. Santos et al. (2007) identificaram que desajustes em próteses cimentadas podem ser a causa mais provável de geração de força de cisalhamento. Na literatura (BUZAYAN et al., 2014), valores como 50 µm e 120 µm já foram relatados, no entanto, não há um consenso sobre a magnitude do desajuste clinicamente aceitável (BORBA et al., 2013; PARK et al., 2015).

A interface de união do implante-*abutment* pode apresentar formas geométricas distintas externas ou internamente (BINON, 2000). A primeira interface introduzida no mercado, e com um longo histórico de previsibilidade clínica, foi a externa (BRÄNEMARK et al., 1977). Nessa interface, o componente anti-rotacional hexagonal é o mais utilizado; entretanto, a taxa de afrouxamento com esse tipo de interface tem se mostrado entre 6 e 48% (ASSUNÇÃO et al., 2012). Com a finalidade de promover um tratamento cada vez mais previsível e com a preservação dos tecidos moles, especialmente na região anterior da maxila ou região estética, surgiu no mercado a interface cônica interna (BUSER et al., 2017; BINON, 2000).

Alguns estudos mostraram que a interface cônica interna apresenta maior estabilidade mecânica, melhor distribuição de forças e menor perda óssea peri-implantar quando comparada com a interface hexagonal externa (PEÑARROCHA-DIAGO et al., 2013; UGUREL et al., 2015). Lin et al. (2013), entretanto, não observaram diferenças estatisticamente significativas na menor perda óssea peri-implantar durante a fase de cicatrização entre os dois tipos de interface. Em uma revisão sistemática, Lauritano et al. (2020) concluíram que, dentre as interfaces hexagonal externa, cônica interna e a mista, nenhuma foi capaz de fornecer uma adaptação perfeita. Todas as conexões apresentaram um nível de desajuste na interface implante-*abutment*, embora os sistemas de conexão cônica e mista apresentaram um comportamento melhor. No geral, um desajuste de 10 µm foi apresentado por implantes de conexão externa, enquanto os implantes de conexão cônica apresentaram um desajuste de 2–3 µm.

A radiografia intrabucal desempenha um papel importante no diagnóstico dos desajustes (KAN et al., 1999; KONERMANN et al., 2010), pois pode ajudar a detectá-los quando usada adequadamente em conjunto com outras modalidades diagnósticas (MAUAD et al., 2021; BACCHI et al., 2013; TSUGE et al., 2008). Dentre as técnicas radiográficas periapicais, destaca-se a técnica do paralelismo padrão (PTP), também conhecida como técnica do "cone longo". Nessa técnica há o emprego de posicionadores radiográficos específicos que distanciam o receptor de imagem do objeto, visando a sua manutenção em relação de paralelismo com o plano longitudinal do objeto a ser radiografado; o feixe central de raios X é orientado perpendicularmente ao receptor de imagem e ao objeto (FREITAS; ROSA; SOUZA, 2000).

Uma variação da PTP consiste na técnica paralelismo modificado (PTM), descrita por Lin et al. (2014), na qual é confeccionado um guia de paralelismo personalizado feito com o registro oclusal dos dentes adjacentes, sem a necessidade de remoção do implante. O guia permite a individualização da técnica, de maneira que as radiografias sejam realizadas numa relação de paralelismo entre receptor de imagem e implante, considerando a sua inclinação no osso alveolar. Entretanto, a técnica é apropriada apenas para implantes com dentes adjacentes.

Na técnica da bissetriz (PTB) o feixe de raios X é orientado perpendicularmente ao plano bissetor virtual formado entre os planos longitudinais do objeto e do receptor de imagem. A PTB pode ser realizada com o auxílio de posicionadores radiográficos que determinam a angulação vertical do feixe central de raios X a ser utilizada, de forma que o feixe principal incida perpendicularmente ao plano bissetor virtual (FREITAS; ROSA; SOUZA, 2000; WHAITES, 2009).

Em revisão sistemática com o objetivo de avaliar a qualidade dos métodos radiográficos para o diagnóstico de desajustes em próteses e restaurações dentárias, Liedke et al. (2014) encontraram 446 publicações nas bases de pesquisa. Dessas, apenas 14 artigos foram incluídos, com dois ou mais métodos radiográficos comparados para diagnosticar desajustes em próteses e em restaurações. A maioria dos estudos usaram radiografias convencionais, quatro utilizaram radiografias digitais e nenhum avaliou o uso de tomografia computadorizada. Todos os estudos incluídos concluíram que a PTP é mais precisa para detecção de desajustes, mas advertiram que as evidências que apoiam o uso desse método para o diagnóstico de desajustes em próteses dentárias e restaurações se limitam a estudos de baixa (8 estudos) a moderada (6 estudos) qualidade, conforme os critérios de Avaliação da Qualidade dos Estudos de Acurácia de Diagnóstico (QUADAS). O QUADAS consiste em uma ferramenta utilizada para avaliar riscos de viés, aplicabilidade e qualidade da redação dos artigos incluídos em revisões sistemáticas (WHITING et al., 2003). Ainda, os autores observaram, em alguns estudos, que angulações verticais maiores do que 15° não permitiram uma avaliação adequada.

As radiografias intrabucais possuem algumas limitações para a detecção de desajustes, principalmente relacionadas à projeção geométrica de estruturas protéticas em imagens radiográficas bidimensionais. A projeção ortogonal é referida como a mais precisa (BEGONA ORMAECHEA; MILLSTEIN; HIRAYAMA, 1999; CAMERON et al., 1998; GALASSO et al., 2000). Para Cameron et al. (1998), quando a angulação vertical entre o feixe de raios X e o objeto for maior do que 20 graus, há uma maior dificuldade na detecção de desajustes na interface implante-*abutment*. Sharkey et al. (2011) produziram desadaptações de 0, 7, 12, 25, 38, 51, 63, 76, 88, 102, 114, 127, e 190 µm na interface implante-*abutment* e radiografaram os espécimes com um posicionador, numa angulação vertical que variou entre 0º e 35º. Observaram que desajustes tão pequenos quanto 12,7 µm podem ser detectados de forma confiável em radiografias obtidas com até 5º de angulação vertical.

Cançado Oliveira et al. (2016) compararam a eficácia de radiografias convencionais (obtidas com filmes e processadas quimicamente segundo os métodos manual e automático), com aquela obtida com o uso de radiografias digitais na detecção de desajustes na interface implante-*abutment.* Os autores simularam desajustes de 8,66 a 95,22 µm e avaliaram sete corpos de prova, cada um com um desajuste vertical diferente entre o *abutment* e a plataforma do implante. A microscopia eletrônica de varredura foi utilizada para confirmar o desajuste e medi-lo, sendo considerada padrão de referência. As imagens obtidas por meio da radiografia convencional com processamento manual e automático apresentaram diferenças estatisticamente significativas em relação à medida do padrão de referência ($p < 0,05$). Os autores concluíram que as imagens digitais constituem o método de diagnóstico de escolha para avaliar desajustes na interface implante-*abutment*, enquanto as imagens radiográficas convencionais não fornecem informações suficientes para tal avaliação.

Darós et al. (2018) avaliaram a acurácia de quatro técnicas radiográficas intrabucais para a detecção de desajustes na interface implante-*abutment*. Os autores utilizaram 20 protótipos de mandíbulas e maxilas obtidos a partir de exames de tomografia computadorizada de feixe cônico de 20 pacientes com perfis esqueléticos diferentes. As mandíbulas e maxilas eram parcialmente desdentadas e articuladas entre si, objetivando simular a cavidade bucal de pacientes. Além disto, os protótipos possuíam molas para permitir a abertura e o fechamento da mandíbula, para a inserção dos posicionadores radiográficos e simulação de uma situação clínica próxima do real. Um implante do tipo hexágono externo foi instalado em cada protótipo, na região do primeiro molar superior direito. A simulação de desajustes foi realizada mediante a inserção de tiras de poliéster de espessura predeterminada. Foram inseridas 1 tira de poliéster (grupo 50 µm) e 3 tiras de poliéster (grupo 150 µm) na interface implante-*abutment*. Dentre os resultados obtidos, DARÓS et al. (2018) concluíram que a PTP, PTM e interproximal são as técnicas radiográficas mais precisas para avaliar desadaptações na interface implante-*abutment* quando comparadas à PTB. As desadaptações no grupo 150 µm foram mais facilmente detectadas do que as do grupo 50 µm, porém isso foi observado somente para a técnica da bissetriz ($p < 0,05$), tendo em vista que a sensibilidade para o grupo 150 µm foi de 68,75%, enquanto para o grupo 50 µm foi de 38,75%. Já nas outras técnicas a sensibilidade para os dois grupos foi maior do que 66,25%.

Dentro das limitações do estudo de Darós et al. (2018), destaca-se o fato de somente a região de molares ter sido avaliada, na qual o ângulo vertical do feixe de raios X é de 20° a 30° para a técnica da bissetriz. Pressupõe-se, com isto, que as limitações da PTB sejam ainda maiores para regiões estéticas da maxila, visto que as angulações a serem utilizadas serão maiores. Além disso, a literatura demonstra que um diagnóstico correto para desajustes de 150 µm será possível apenas quando o ângulo formado entre o feixe central de raios X e a superfície a ser radiografada não seja maior do que 15° (BEGONA ORMAECHEA; MILLSTEIN; HIRAYAMA, 1999).

Observa-se poucos estudos na literatura que simularam cenários clínicos para avaliar a acurácia de técnicas radiográficas intrabucais na detecção de desajustes nas interfaces *abutment*-prótese. Darós et al. (2016) avaliaram técnicas intrabucais para o diagnóstico de desajustes na interface implante-*abutment* em implantes com conexão externa hexagonal. Estudos de acurácia diagnóstico com técnicas intrabucais para o diagnóstico de desajustes na interface implante-*abutment* em implantes com conexão cônica interna (*cone morse*) se tonam inviáveis devido ao formato anatômico da conexão. Contudo, esse é o tipo de implante mais usual na região estética onde, para além dos desajustes na interface implante-*abutment*, outros problemas relacionados à linha de cimentação podem contribuir para o aumento de tensões indesejáveis e de doenças peri-implantares, principalmente quando temos uma condição de diagnóstico desfavorável para avaliar tal estrutura. Além disso, as evidências que apoiam o uso de técnicas intrabucais para o diagnóstico de desajustes em próteses dentárias e restaurações se limitam a estudos de baixa a moderada qualidade, conforme os critérios QUADAS. Assim, observa-se a necessidade de aprofundar investigações acerca das técnicas radiográficas mais apropriadas para se detectar desajustes na interface *abutment*-prótese em implantes com conexão cônica interna na região estética.

2 OBJETIVOS

2.1 OBJETIVO GERAL

Comparar a acurácia de 3 técnicas radiográficas intrabucais (PTB, PTP e PTM) na detecção de desajustes na interface *abutment*-prótese em implantes com conexão cônica interna na região estética.

2.2 OBJETIVOS ESPECÍFICOS

- Observar se há menor acurácia nas radiografias obtidas pela PTB para o diagnóstico de desajustes na interface *abutment*-prótese;
- Observar se a magnitude do desajuste na interface *abutment*-prótese influencia na acurácia do diagnóstico.

3 ARTIGO

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Detecção de desajustes na interface *abutment*-prótese na região estética: implicações da técnica radiográfica e da magnitude do desajuste

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RESUMO

Descrição do problema. Desajustes na interface abutment-prótese representam um contratempo para o tratamento reabilitador com implantes dentários. As radiografias periapicais são utilizadas como método auxiliar na avaliação de desajustes na interface abutment-prótese, entretanto as evidências que suportam o uso desse método ainda são restritas a estudos de baixa a moderada qualidade. Além disto, há uma lacuna na literatura quanto a estudos de acurácia envolvendo técnicas periapicais para avaliar desajustes na interface abutment-prótese na região estética.

Objetivo. Comparar a acurácia de 3 técnicas radiográficas periapicais na detecção de desajustes na interface abutment-prótese em região estética e avaliar se a magnitude do desajuste influencia no diagnóstico.

Material e métodos. Quinze implantes com conexão cônica interna foram instalados na região de incisivo central em maxilas de poliamida e copings para coroas cimentadas personalizados foram confeccionados em cerâmica por meio de sistema CAD/CAM. Desajustes de 50, 100 e 150 μm foram simulados por meio da interposição de 1, 2 ou 3 tiras de poliéster de 50 μm de espessura, respectivamente, posicionada(s) na interface abutment-prótese; a ausência da tira representou o grupo controle. Radiografias digitais foram obtidas utilizando-se posicionadores para as seguintes técnicas periapicais: bissetriz (PTB), paralelismo (PTP) e paralelismo modificado (PTM). Um total de 180 radiografias digitais foi avaliado por 2 radiologistas e 1 protesista. Os valores de área sob curva característica de operação do receptor (Az) foram submetidos ao teste de Friedman com *post-hoc* de Durbin-Conover ($\alpha = 5\%$).

Resultados: Diferenças estatística ($p < 0.05$) foram observadas entre a as técnicas PTP (Az = 0.873) e PTB (Az = 0.753) para magnitude 50 μm, sendo a PTP mais acurada. Magnitudes maiores apresentaram maior acurácia em relação às magnitudes menores ($p < 0.05$). Nas interações técnica e magnitude, todas as comparações tiveram diferenças estatísticas ($p < 0.05$), exceto para PTP magnitude 100 μm (Az = 0.976) e a PTM magnitude 150 μm (Az = 0.998).

Conclusão. A PTP foi mais acurada do que a PTB para detectar desajustes de 50 μm na interface abutment-prótese e desajustes maiores resultaram em diagnósticos mais acurados independentemente da técnica utilizada.

IMPLICAÇÕES CLÍNICAS

Ainda não há, na literatura, um protocolo bem estabelecido para avaliar desajuste na interface abutment-prótese em implantes com conexão cônica interna localizados na região estética. Diante dos achados deste estudo, a técnica radiográfica intrabucal do paralelismo se mostra mais adequada para esse fim.

INTRODUÇÃO

Desajustes na interface abutment-prótese representam um contratempo para o tratamento reabilitador com implantes dentários[1-4] e podem resultar no aumento de tensões indesejáveis e no desenvolvimento de doenças peri-implantares. [2,5-8] Embora uma tolerância biológica de 100 μm ao desajuste seja aceita para o ajuste passivo,[5,6] não há um consenso sobre a magnitude do desajuste aceitável,[9] embora valores como 50 μm e 120 μm já tenham sido relatados.[10,11] Também não há concordância na literatura sobre qual dos métodos de retenção da prótese ao abutment (isto é, fixação por parafuso ou cimentação) desempenha maior durabilidade, ainda que o excesso de cimento possa vir a comprometer a osseointegração.[7,12-14] Todavia, a prótese cimentada é indicada para regiões estéticas.[5,15]

Apesar das limitações relacionadas à projeção geométrica de estruturas protéticas em imagens bidimensionais,[16,17] as radiografias intrabucais apresentam o melhor desempenho em relação à tomografia computadorizada de feixe cônico para a avaliação de desajustes em coroas protéticas[18] e são indicadas para avaliação de desajustes na interface implante-abutment.[19,20] Imagens radiográficas também foram utilizadas para avaliar excesso residual de cimento em implantes.[21] Quando comparada à radiografia convencional, a radiografia digital é o método de escolha para avaliar desajustes na interface implante-abutment,[22,23] especialmente aquelas obtidas em sistemas de placas de fósforo, independentemente do software de visualização e do uso de filtros de imagem.[23,24]

A seleção da técnica radiográfica desempenha um papel importante na avaliação de desajustes.[19,20] A técnica do paralelismo (PTP) é referida como a mais precisa para a detecção de desajustes, particularmente se comparada à técnica da bissetriz (PTB).[25,26] O ângulo de projeção desempenha um papel importante na precisão da detecção, pois angulações verticais maiores que 15° podem prejudicar até mesmo a detecção de desajustados maiores, que são considerados mais facilmente vistos do que menores.[16,19,20,22,26,27]

Apesar da literatura existente sobre o diagnóstico radiográfico de desajustes protéticos sobre implantes, as evidências que suportam o uso de métodos radiográficos para este fim foram consideradas como de baixa a moderada qualidade segundo os critérios de Avaliação da Qualidade dos Estudos de Acurácia de Diagnóstico (QUADAS).[25] Além disso, parece não haver estudos relacionados à detecção radiográfica de desajustes na interface abutment-prótese em implantes instalados na região estética, onde implantes com conexão cônica interna são mais usuais. Assim, devido à falta de um protocolo de avaliação sistemático e eficaz para diagnosticar desajustes na interface abutment-prótese, o presente estudo teve como objetivo comparar a acurácia de 3 técnicas periapicais PTB, PTP e técnica do paralelismo modificado (PTM) na detecção de desajustes na interface abutment-prótese em implantes com conexão cônica interna na região estética. Além disso, este estudo também teve como objetivo investigar se a magnitude dos desajustados influencia a precisão diagnóstica das técnicas estudadas em condições clínicas simuladas nas quais o ângulo vertical dos raios-X é maioritariamente superior a 15°. As hipóteses nulas eram de que a técnica radiografia e as magnitudes não afetariam a precisão da detecção de desajustes.

MATERIAL E MÉTODOS

Mediante aprovação pelo Comitê de Ética em Pesquisa com Seres Humanos (CAAE 42616720.3.0000.5060), este estudo de acurácia experimental *in vitro* envolveu a utilização de 15 protótipos de mandíbulas e maxilas obtidos a partir de exames de tomografia computadorizada de feixe cônico, conforme metodologia previamente reportada na literatura.[26] Em cada maxila, um implante com conexão cônica interna (Tryon Morse; S.I.N. Implant System) de 11,5 mm de comprimento e plataforma regular de 4,5 mm de diâmetro foi inserido na região do incisivo central superior esquerdo por um especialista em Implantodontia com 10 anos de experiência. Sob abundante irrigação com solução fisiológica, os implantes foram inseridos com o ombro do implante no nível da crista óssea alveolar. Nas demais regiões, a dentição normal intacta foi mantida. O programa MedCalc (Software MedCalc; MedCalc) auxiliou no cálculo do tamanho mínimo da amostra para comparação de Curvas Características de Operação do Receptor (ROC), estimando um valor de área sob a curva (Az) de 0,7, com alfa de 5%, beta de 20% e uma relação desajuste/ajuste de 1:1. O número amostral baseou-se em parâmetros de estudos prévios.[17,20,26,27]

Abutments do tipo universal reto de 4,5 mm de diâmetro (Tryon Morse; S.I.N. Implant System) foram instalados a 20 N.cm e copings personalizados foram confeccionados em cerâmica por meio de sistema CAD/CAM (Amann; Ceramill® Motion 2). Os desajustes foram simulados pela inserção de tiras de poliéster de espessura predeterminada de 50 µm (Fita Matriz de Poliéster; TDV Dental) na interface abutment-prótese. Um orifício circular de aproximadamente 4,5 mm de diâmetro foi confeccionado no centro de cada tira de poliéster para assegurar um contato uniforme da superfície do abutment e a superfície inferior do coping. Foram inseridas 1 tira de poliéster (grupo 50 µm), 2 tiras de poliéster (grupo 100 µm) e 3 tiras de poliéster (grupo 150 µm) na interface abutment-prótese. Para garantir a adesão entre as peças e simular uma cimentação, o coping foi preenchido internamente com 0,02 ml de silicona de condensação do tipo leve (Speedex Putty; Coltene). As quantidades utilizadas do fluido e catalizador foram de acordo com as instruções do fabricante. Em seguida, a peça era levada em posição sobre o abutment, aplicando-se pressão digital por 6 minutos. Decorrido esse intervalo de tempo, eram realizadas as radiografias. No grupo controle (ausência de tiras de poliéster), o coping foi instalado diretamente sobre o abutment. Este grupo foi examinado para determinação do padrão de referência utilizando microscopia eletrônica de varredura (MEV) (JSL- 6610LV JEOL; Scanning Electron Microscopy) com aumento de 100x (Figura 1).

Um único operador treinado (V.P.O.M.) radiografou os implantes usando posicionadores para PTB (Cone Indicator; Indusbello) e PTP (Rinn-XCP; Dentsply Sirona), enquanto um guia de paralelismo personalizado foi confeccionado para PTM, conforme descrito por Lin et al. (2014).[28] Durante as exposições radiográficas, os protótipos foram posicionados com plano de Frankfurt paralelo ao plano horizontal. Todas as radiografias foram obtidas utilizando-se o mesmo equipamento gerador de raios X (Focus™; Kavo) sob os parâmetros de 70 kVp, 7 mA e 0,1 segundos, com placas de fósforo tipo 1 (periapical), tamanho 2 (31 × 41 mm) (VistaScan Mini Easy; Dürr Dental) Registros oclusais foram confeccionados usando silicona de condensação do tipo pesado (Speedex Putty; Coltene) e adaptados nos posicionadores para padronizar as incidências radiográficas entre as diferentes magnitudes de desajuste simuladas. Um total de 180 radiografias foram obtidas, considerando as 3 técnicas radiográficas (PTB, PTP, PTM), 4 condições de desajustes (controle 0 µm, 50 µm, 100 µm, 150 µm). A Figura 2 ilustra o posicionamento radiográfico nos protótipos.

Três avaliadores (um protesista e duas radiologistas odontológicas), com mais de 5 anos de experiências em suas áreas, foram treinados previamente às avaliações por meio da análise de imagens de ajuste e desajuste não pertencentes ao estudo. As imagens foram avaliadas em um computador desktop DELL Optiplex 790, no visualizador de imagens do Windows (Windows imaging viewer; Microsoft Corp), sob condições de iluminação reduzida e a ampliação (zoom) foi a única ferramenta permitida. Os avaliadores não tiveram acesso ao padrão de referência, de maneira a não influenciar nas avaliações das imagens. Exemplos das radiografias obtidas no estudo podem ser visualizadas na Figura 3. As respostas sobre o desajuste na interface abutment-prótese poderiam ser "definitivamente presente", "provavelmente presente", "incerto", "provavelmente ausente" e "definitivamente ausente".

Trinta dias após a avaliação, 20% das imagens foram reavaliadas para análise de reprodutibilidade intra e interexaminador. As reprodutibilidades intra e interavaliador foram analisadas pelo teste Kappa ponderado e a sua interpretação seguiu parâmetros descritos na literatura.[29] Foram realizadas análises descritivas dos valores de área sob curva característica de operação do receptor (Az). A curva traçada sobre o gráfico é baseada na resposta dos avaliadores numa escala de 5 pontos, onde cada escore significa um ponto de corte sobre o gráfico. Por apresentarem distribuição não-paramétrica ($W = 0.808$; $p < 0,01$), os valores de Az foram submetidos à versão não-paramétrica do teste ANOVA para medidas repetidas (Friedman) com teste post-hoc de Durbin-Conover. O nível de significância foi adotado em 5%. A hipótese nula considerou não haver diferença entre as técnicas radiográficas e magnitudes para o diagnóstico dos desajustes.

RESULTADOS

As reprodutibilidades intra e interexaminadores variaram de moderada a quase perfeita e moderada a substancial, respectivamente. (Tabela 1). [29]

A Tabela 2 mostra uma análise descritiva dos valores de Az. Considerando a magnitude de 50 μm, os valores medianos de Az foram descritivamente maiores para a PTP (0.873) se comparados à PTM (0.824) e PTB (0.753). O mesmo padrão pôde ser observado para a magnitude 100 μm (PTP = 0.976, PTM = 0.971, PTB = 0.956). Para a magnitude 150 μm, o menor valor mediano de Az foi encontrado para PTM (0.998), embora muito próximo de PTP e PTB (ambos 1.000) (Tabela 2). Na figura 4 é possível observar as curvas ROC geradas no estudo.

Os valores de Az apresentaram diferenças estatisticamente significantes ($\chi^2 = 22.0$; $p < 0,05$). Os resultados do teste de comparações múltiplas (Durbin-Conover) podem ser observados na tabela 3; em negrito constam todas as comparações com diferenças estatísticas ($p < 0,05$). Considerando o fator técnica foi encontrada diferença estatística ($p < 0.05$) apenas para a PTP (Az = 0.873) em comparação com a PTB (Az = 0.753) para magnitude 50 μm, sendo a PTP mais acurada. Para o fator magnitude foi observada diferença estatística em todas as situações ($p < 0.05$); magnitudes maiores apresentaram maior acurácia em relação às magnitudes menores. Para a interação dos fatores técnica e magnitude, todas as comparações tiveram diferenças estatísticas ($p < 0.05$), exceto para PTP magnitude 100 μm (Az = 0.976) e a PTM magnitude 150 μm (Az = 0.998), tendo em vista que os valores de Az foram próximos. Nas análises das interações, pôde se observar que magnitudes maiores influenciaram para maiores acurácias.

Na tabela 4 é possível observar os valores de mediana, mínimo e máximo das angulações verticais indicadas no goniômetro do aparelho de raios X durante as exposições radiográficas. O valor mediano para PTB (42,5º) foi superior do que PTP (32,5º) e PTM (30º).

DISCUSSÃO

Os dados coletados no estudo permitiram a rejeição da hipótese nula, pois houve diferença entre as técnicas radiográficas e entre as magnitudes na detecção de desajustes na interface abutment-prótese. Embora não se tenha conhecimento de estudos que compararam técnicas intrabucais para detecção de desajustes na interface abutment-prótese, nossos achados relacionados aos desajustes de 50 μm corroboram estudos prévios que avaliaram a interface implante-abutment, uma vez que PTP (técnica ortogonal) resultou em maior acurácia do que a PTB (técnica não-ortogonal).[20,25-27] Em uma revisão histórica sobre posicionadores, Dixon[30] descreveram que o posicionador para a PTB desenvolvido por Updegrave[31] inevitavelmente produzia distorções dimensionais, o que poderia dificultar a interpretação e o diagnóstico precisos. Por outro lado, o posicionador da PTP, desenvolvido por Updegrave,[32] foi recomendado como a técnica de escolha para a produção de radiografias de alta qualidade.

Quando a mesma magnitude foi considerada, não encontramos diferenças estatísticas entre a PTM proposta por Lin et al[28] e a PTP, assim como Darós et al.[26] Por outro lado, Lin et al[28] concluíram que a PTM foi mais acurada do que a PTP para desajustes de 50 e 100 μm. Acreditamos que essas diferenças possam ter ocorrido pelo fato do dispositivo para a PTM ter sido desenvolvido para implantes instalados na região posterior e, em nosso estudo a técnica foi adaptada para a região anterior. Também não foi encontrada diferença estatística para a PTB em comparação à PTM para desajustes de 50 µm. Em relação ao fator magnitude, os desajustes maiores foram mais facilmente detectados do que os menores, o que corrobora achados de estudos prévios.[16,19,22,25-.27] Na análise das interações entre os fatores técnica e magnitude, observamos que a magnitude influenciou sobremaneira nos resultados encontrados, tendo em vista que quase todas as comparações resultaram em diferenças estatísticas, o que demonstrou que magnitudes maiores favoreceram a uma maior acurácia independentemente da técnica utilizada. Vale ressaltar que apenas a comparação entre PTP magnitude 100 µm (Az = 0.976) e a PTM magnitude 150 µm (Az = 0.998) não apresentou diferenças estatísticas.

Estudos sugerem que angulações maiores do que 15° não permitiriam uma avaliação adequada, independentemente do tamanho do desajuste.[16,20,27] Em nosso estudo, entretanto, desajustes maiores foram observados em angulações medianas de 30º a 42,5º. Acreditamos que essa diferença ocorreu pelo fato dos estudos de Begona,[16] Papavassiliou et al[20], e Sharkey et al.[27] não terem utilizado posicionadores para obter as radiografias, mas sim variação da angulação vertical em um cenário laboratorial, que não reproduzia necessariamente a prática clínica. Vale ressaltar, entretanto, que mesmo utilizando posicionadores, a PTB obteve a maior angulação vertical em relação às PTP e PTM.

A radiografia digital foi utilizada neste estudo pois se constitui no método de diagnóstico de escolha para avaliar desajustes na interface implante-abutment, quando comparadas às radiografias convencionais.[22,23] Entretanto, um sistema de placas de fósforo foi utilizado, diferentemente de Cançado Oliveira et al,[22] pois foi demonstrado que o uso de placas de fósforo influencia positivamente na acurácia de diagnóstico para a detecção de desajustes na interface implante-prótese.[23] Da mesma maneira, o visualizador de imagens do Windows foi utilizado para a avaliação das radiografias, uma vez que estudo anterior não encontrou diferenças entre esse software e os do sistema radiográfico.[23] Não foi permitido o uso de filtros de imagem pelos avaliadores para não introduzir mais uma variável ao estudo, embora a sua aplicação não tenha influenciado significativamente a acurácia de diagnóstico da detecção de desajuste na interface implante-prótese em estudo anterior.[24]

Embora nosso estudo se propôs a avaliar a acurácia de técnicas radiográficas intrabucais para a detecção de desajustes na interface abutment-prótese, Wadhwani et al[21] analisaram o uso da radiografia intrabucal para a detecção do excesso de cimento na interface abutment-prótese. Contudo, esses autores não avaliaram a influência da magnitude desse excesso. Segundo a norma nº 8 da New American Dental Association Specification, a espessura de cimentação deve atingir no máximo 25 µm, o que é contestado por alguns autores, que consideram 50 a 100 µm mais indicado.[33] Tendo em vista que há uma demanda por protocolos de diagnóstico com esta finalidade, sugere-se que estudos de diagnóstico futuros avaliem a influência da magnitude do excesso de cimento, visando maiores esclarecimentos sobre o tema.

Dentre as limitações do nosso estudo, optamos por não avaliar a região anterior inferior devido à ausência, no protótipo, da língua e musculatura adjacente, o que faria com que o posicionamento radiográfico não reproduzisse a situação clínica. Outra limitação refere-se ao fato dos protótipos não conseguirem reproduzir a densidade óssea radiográfica. Contudo, o desenho do estudo é inviável de ser realizado com pacientes do ponto de vista ético, pelo fato de que o paciente não deve ser submetido à exposição de radiação desnecessária.

CONCLUSÃO

Com base nos resultados deste estudo in vitro, concluiu-se que:

1) A PTP foi mais acurada do que a PTB para detectar desajustes de 50 µm na interface abutment-prótese.

2) Desajustes maiores resultaram em diagnósticos mais acurados independentemente da técnica utilizada.

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TABELAS

Tabela 1. Valores de kappa ponderado para reprodutibilidades intra e interexaminadores

	Técnica Radiográfica		
Intraexaminador	**PTB**	**PTP**	**PTM**
Mínimo	0,550	0,584	0,659
Máximo	0,674	0,871	0,868
Mediana	0,593	0,685	0,700
Interexaminador			
Mínimo	0,674	0,676	0,591
Máximo	0,716	0,772	0,662
Mediana	0,674	0,716	0.64

PTB. Técnica periapical da bissetriz; PTP. Técnica periapical do paralelismo; PTM. Técnica periapical do paralelismo modificada.

Tabela 2. Análise descritiva dos valores de Az obtidos no estudo.

Grupo	Mediana	Desvio interquartílico	Mínimo	Máximo
PTB-50	0.753	0.015	0.753	0.784
PTB-100	0.956	0.023	0.940	0.987
PTB-150	1.000	0.016	0.967	1.000
PTP-50	0.873	0.050	0.822	0.922
PTP-100	0.976	0.022	0.940	0.984
PTP-150	1.000	0.000	1.000	1.000
PTM-50	0.824	0.032	0.807	0.871
PTM-100	0.971	0.008	0.962	0.978
PTM-150	0.998	0.016	0.967	1.000
Total	0.967	0.120	0.753	1.000

PTB-50. Técnica periapical da bissetriz com 50 µm de magnitude do desajuste; PTB-100. Técnica periapical da bissetriz com 100 µm de magnitude do desajuste; PTB-150. Técnica periapical da bissetriz com 150 µm de magnitude do desajuste; PTP-50. Técnica periapical do paralelismo com 50 µm de magnitude do desajuste; PTP-100. Técnica periapical do paralelismo com 100 µm de magnitude do desajuste; PTP-150. Técnica periapical do paralelismo com 150 µm de magnitude do desajuste; PTM-50. Técnica periapical do paralelismo modificado com 50 µm de magnitude do desajuste; PTM-100. Técnica periapical do paralelismo modificado com 100 µm de magnitude do desajuste; PTM-150. Técnica periapical do paralelismo modificado com 150 µm de magnitude do desajuste.

Tabela 3. Resultados do teste de comparações múltiplas (Durbin-Conover).

Comparação	Estatística	p	Fator em estudo
PTB-50 x PTB-100	**4.717**	**< .001**	**Magnitude**
PTB-50 x PTB-150	**8.577**	**< .001**	**Magnitude**
PTB-50 x PTP-50	**2.573**	**0.020**	**Técnica**
PTB-50 x PTP-100	**6.433**	**< .001**	**Técnica x Magnitude**
PTB-50 x PTP-150	**9.649**	**< .001**	**Técnica x Magnitude**
PTB-50 x PTM-50	1.287	0.217	Técnica
PTB-50 x PTM-100	**5.146**	**< .001**	**Técnica x Magnitude**
PTB-50 x PTM-150	**7.934**	**< .001**	**Técnica x Magnitude**
PTP-50 x PTB-100	**2.144**	**0.048**	**Técnica x Magnitude**
PTP-50 x PTB-150	**6.004**	**< .001**	**Técnica x Magnitude**
PTP-50 x PTP-100	**3.860**	**0.001**	**Magnitude**
PTP-50 x PTP-150	**7.076**	**< .001**	**Magnitude**
PTP-50 x PTM-50	1.287	0.217	Técnica
PTP-50 x PTM-100	**2.573**	**0.020**	**Técnica x Magnitude**
PTP-50 x PTM-150	**5.361**	**< .001**	**Técnica x Magnitude**
PTM-50 x PTB-100	**3.431**	**0.003**	**Técnica x Magnitude**
PTM-50 x PTB-150	**7.290**	**< .001**	**Técnica x Magnitude**
PTM-50 x PTP-100	**5.146**	**< .001**	**Técnica x Magnitude**
PTM-50 x PTP-150	**8.362**	**< .001**	**Técnica x Magnitude**
PTM-50 x PTM-100	**3.860**	**0.001**	**Magnitude**
PTM-50 x PTM-150	**6.647**	**< .001**	**Magnitude**
PTB-100 x PTB-150	**3.860**	**0.001**	**Magnitude**
PTB-100 x PTP-100	1.715	0.106	Técnica
PTB-100 x PTP-150	**4.932**	**< .001**	**Técnica x Magnitude**
PTB-100 x PTM-100	0.429	0.674	Técnica
PTB-100 x PTM-150	**3.216**	**0.005**	**Técnica x Magnitude**
PTP-100 x PTB-150	**2.144**	**0.048**	**Técnica x Magnitude**
PTP-100 x PTP-150	**3.216**	**0.005**	**Magnitude**
PTP-100 x PTM-100	1.287	0.217	Técnica
PTP-100 x PTM-150	1.501	0.153	Técnica x Magnitude
PTM-100 x PTB-150	**3.431**	**0.003**	**Técnica x Magnitude**

PTM-100 x PTP-150	**4.503**	**< .001**	**Técnica x Magnitude**
PTM-100 x PTM-150	**2.787**	**0.013**	**Magnitude**
PTB-150 x PTP-150	1.072	0.300	Técnica
PTB-150 x PTM-150	0.643	0.529	Técnica
PTP-150 x PTM-150	1.715	0.106	Técnica

PTB-50. Técnica periapical da bissetriz com 50 µm de magnitude do desajuste; PTB-100. Técnica periapical da bissetriz com 100 µm de magnitude do desajuste; PTB-150. Técnica periapical da bissetriz com 150 µm de magnitude do desajuste; PTP-50. Técnica periapical do paralelismo com 50 µm de magnitude do desajuste; PTP-100. Técnica periapical do paralelismo com 100 µm de magnitude do desajuste; PTP-150. Técnica periapical do paralelismo com 150 µm de magnitude do desajuste; PTM-50. Técnica periapical do paralelismo modificado com 50 µm de magnitude do desajuste; PTM-100. Técnica periapical do paralelismo modificado com 100 µm de magnitude do desajuste; PTM-150. Técnica periapical do paralelismo modificado com 150 µm de magnitude do desajuste.

Tabela 4. Valores de angulação vertical utilizada para cada técnica radiográfica.

	Técnica Radiográfica		
	PTB	**PTP**	**PTM**
Mínimo	25º	15º	12,5º
Máximo	70º	47,5º	45º
Mediana	42,5º	32,5º	30º

PTB. Técnica periapical da bissetriz; PTP. Técnica periapical do paralelismo; PTM. Técnica periapical do paralelismo modificada.

FIGURAS

Figura 1 – Grupo controle (sem desajustes) obtido por microscopia eletrônica de varredura (MEV) com ampliação de 100x.

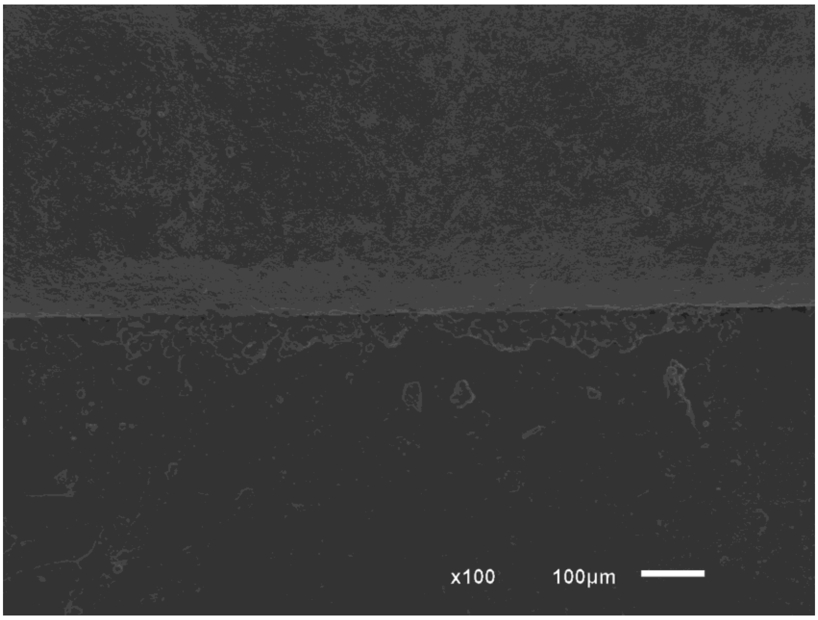


Figura 2 - Posicionadores utilizados para as técnicas. A, Periapical da bissetriz. B, Periapical do paralelismo. C, Periapical do paralelismo modificado.

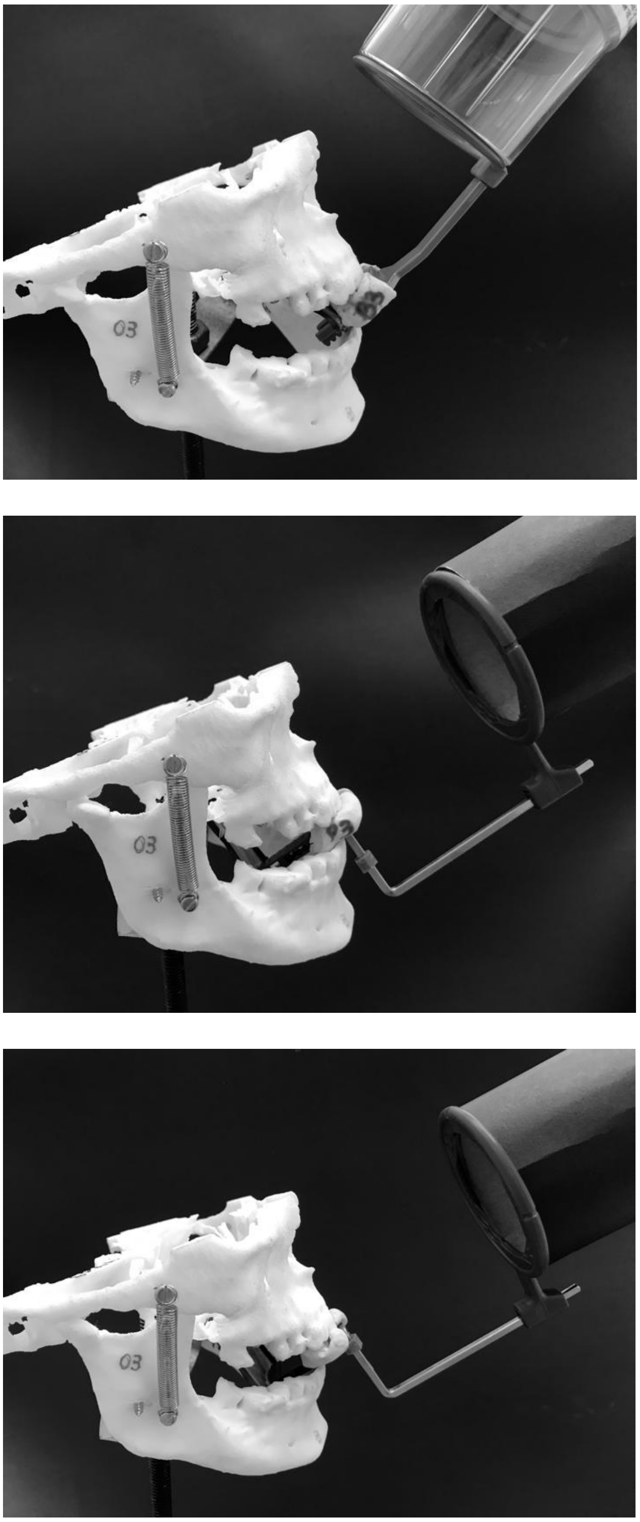
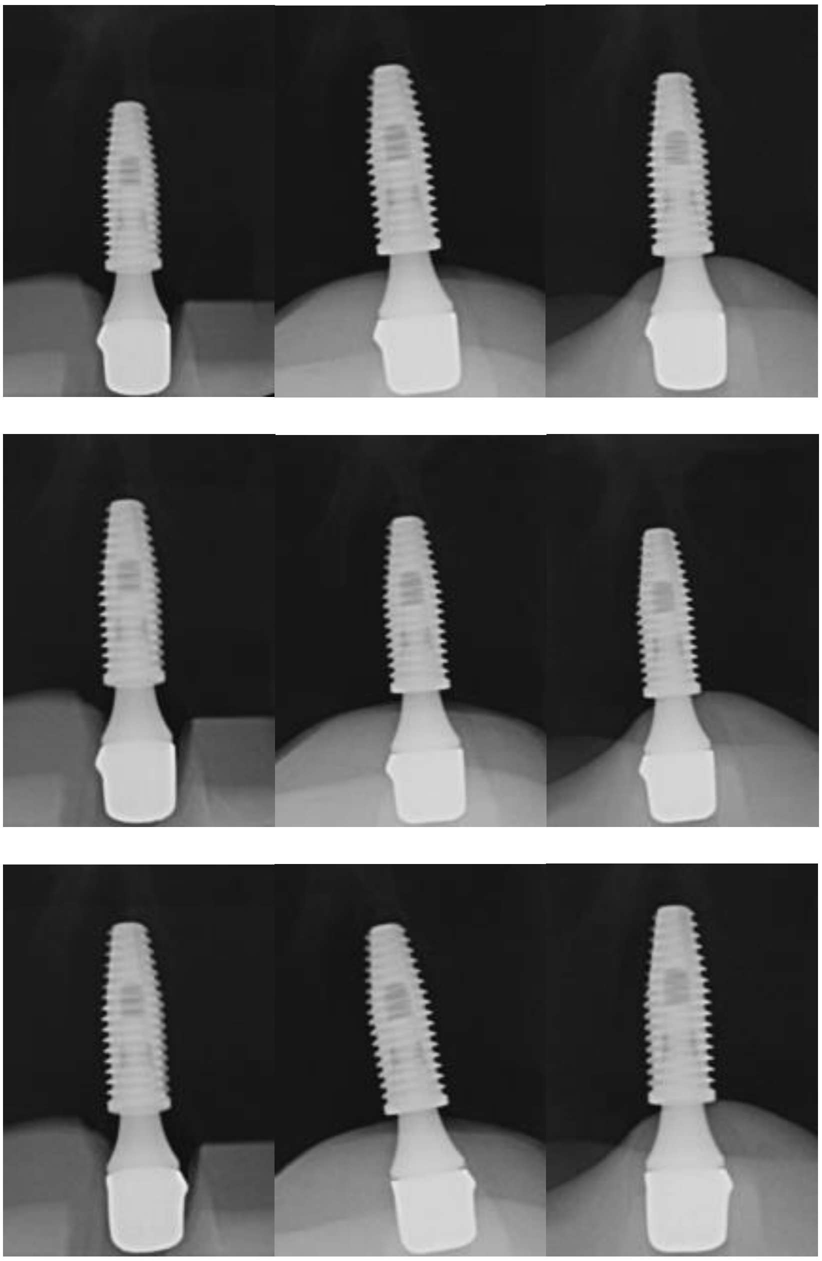


Figura 3 - Radiografias obtidas para estudo. A, Grupo controle. Técnica periapical da bissetriz. B, Grupo controle. Técnica periapical do paralelismo. C, Grupo controle. Técnica periapical do paralelismo modificado. D, Grupo 50 µm. Técnica periapical da bissetriz. E, Grupo 50 µm. Técnica periapical do paralelismo. F, Grupo 50 µm. Técnica periapical do paralelismo modificado. G, Grupo 100 µm. Técnica periapical da bissetriz. H, Grupo 100 µm. Técnica periapical do paralelismo. I, Grupo 100 µm. Técnica periapical do paralelismo modificado. J, Grupo 150 µm. Técnica periapical da bissetriz. K, Grupo 150 µm. Técnica periapical do paralelismo. L, Grupo 150 µm. Técnica periapical do paralelismo modificado.



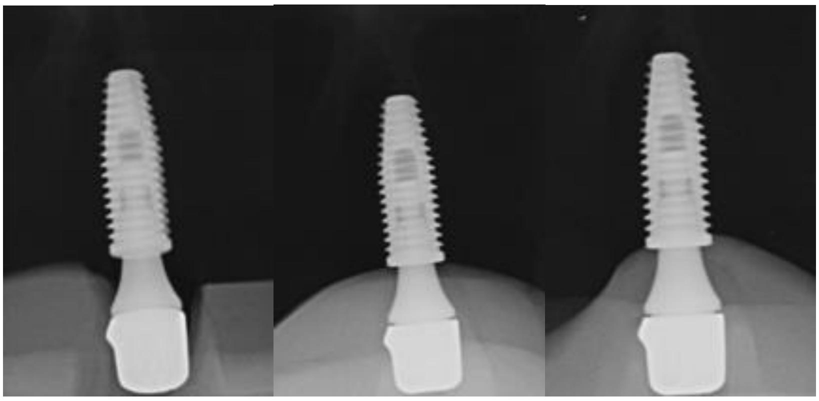
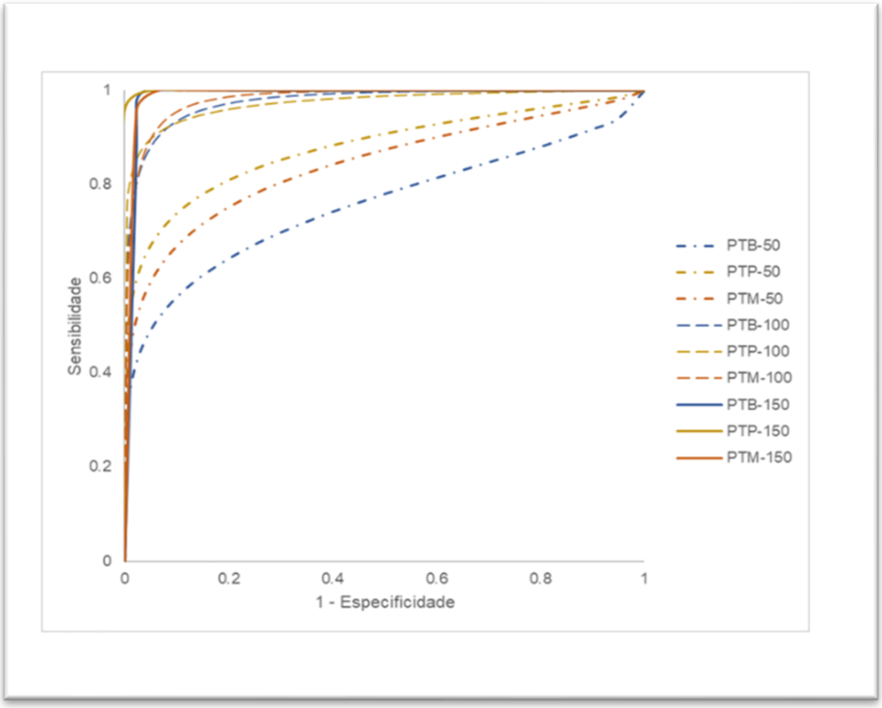


Figura 4 – Curvas Características de Operação do Receptor (ROC) geradas no estudo. PTB-50. Técnica periapical da bissetriz com 50 µm de magnitude do desajuste; PTB-100. Técnica periapical da bissetriz com 100 µm de magnitude do desajuste; PTB-150. Técnica periapical da bissetriz com 150 µm de magnitude do desajuste; PTP-50. Técnica periapical do paralelismo com 50 µm de magnitude do desajuste; PTP-100. Técnica periapical do paralelismo com 100 µm de magnitude do desajuste; PTP-150. Técnica periapical do paralelismo com 150 µm de magnitude do desajuste; PTM-50. Técnica periapical do paralelismo modificado com 50 µm de magnitude do desajuste; PTM-100. Técnica periapical do paralelismo modificado com 100 µm de magnitude do desajuste; PTM-150. Técnica periapical do paralelismo modificado com 150 µm de magnitude do desajuste.



4 CONSIDERAÇÕES FINAIS

- A PTP apresentou maior acurácia do que a PTB para magnitude 50 µm na detecção de desajustes na interface *abutment*-prótese em implantes com conexão cônica interna na região estética.

- A PTB não deve ser utilizada para se detectar desajustes discretos (ex: 50 µm).

- Desajustes de maiores magnitudes resultaram em maior acurácia para o diagnóstico em relação às menores, independentemente da técnica utilizada.

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ANEXOS

ANEXO A - PARECER CONSUBSTANCIADO DO COMITÊ DE ÉTICA EM PESQUISA

UFES - CENTRO DE CIÊNCIAS DA SAÚDE DA UNIVERSIDADE FEDERAL DO ESPÍRITO

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: ACURÁCIA DE DIAGNÓSTICO DE TÉCNICAS RADIOGRÁFICAS INTRABUCAIS NA ANÁLISE DO DESAJUSTE DA INTERFACE IMPLANTE-PRÓTESE NA REGIÃO ANTERIOR DA MAXILA

Pesquisador: Vanessa Pacheco de Oliveira

Área Temática:

Versão: 1

CAAE: 42616720.3.0000.5060

Instituição Proponente: Centro de Ciências da Saúde (CCS)

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 4.581.641

Apresentação do Projeto:

Título do projeto: Acurácia de diagnóstico de técnicas radiográficas intrabucais na análise do desajuste da interface implante prótese na região anterior da maxila

Pesquisador responsável: Vanessa Pacheco de Oliveira

Instituição: Universidade Federal do Espírito Santo

Finalidade acadêmica: Dissertação
Curso: Programa de Pós-graduação em Clínica Odontológica
Local do estudo: Centro de Ciências da Saúde (CCS)

Objetivo da Pesquisa:

Comparar a acurácia de 3 técnicas radiográficas intrabucais: técnica da bissetriz (PTB), técnica do paralelismo (PTP) e a técnica do paralelismo modificado (PTM) na detecção de desajustes na interface implante-prótese IIP em implantes com conexão cônica interna na região anterior da maxila.

Endereço: Av. Marechal Campos 1468
Bairro: S/N **CEP:** 29.040-091
UF: ES **Município:** VITORIA
Telefone: (27)3335-7211 **E-mail:** cep.ufes@hotmail.com

Avaliação dos Riscos e Benefícios:

De acordo com o pesquisador, os riscos e benefícios do projeto são:
"RISCOS: Há um risco de fadiga visual dos avaliadores durante a avaliação das radiografias, o qual será minimizado pela limitação da avaliação de 30 imagens por dia."
"BENEFÍCIOS: Não haverá benefícios diretos aos participantes. Benefícios indiretos são previstos para a área do conhecimento, quanto ao conhecimento acerca da detecção radiográfica de desajustes na interface implante/ prótese"

ANÁLISE DOS RISCOS E BENEFÍCIOS
Projeto de pesquisa potencialmente relevante, com benefícios previstos prevalecendo sobre os riscos. Desta forma, os riscos e benefícios, conforme descritos pelo pesquisador, atendem as exigências da Resolução CNS n° 466/12.

Comentários e Considerações sobre a Pesquisa:

De acordo com os autores, ao redor de implantes pode ocorrer a presença de inflamação que poderá dificultar a osseointegração e caso não seja diagnosticada e tratada adequadamente, poderá levar à perda do implante. Para que a saúde do implante seja mantida a longo prazo e para que não ocorra a peri-implantite e outras complicações, é importante um adequado ajuste da interface implante-prótese (IIP), associada a outros fatores. A radiografia intrabucal pode ajudar a avaliar a desajuste na IIP usada adequadamente em conjunto com outras modalidades de avaliação. Como ainda não há um protocolo determinado, este estudo tem como objetivo geral comparar a acurácia de 3 técnicas radiográficas intrabucais: técnica da bissetriz (PTB), técnica do paralelismo (PTP) e a técnica do paralelismo modificado (PTM) na detecção de desajustes na interface implante-prótese (IIP) em implantes com conexão cônica interna na região anterior da maxila.
bem estabelecido para se avaliar este problema.

Justificativa:
Necessidade de estabeler um protocolo de utilização de técnicas radiográficas.

Hipótese: Este trabalho se destina a testar a hipótese alternativa de que a técnica da bissetriz (PTB) apresenta baixa acurácia para detectar desajustes na interface implante-prótese quando comparado com as técnicas do paralelismo (PTP) e paralelismo modificado (PTM)

Tamanho de amostra
240 radiografias que serão avaliadas por 4 avaliadores das radiografias

Critérios de inclusão cirurgiões-dentistas, alunos do mestrado do programa PPGCO com pelo menos 5 anos de experiência na avaliação de implantes dentários

Metodologia
Trata-se de um estudo de acurácia experimental in vitro, a ser realizado no ambulatório IV, no setor de Radiologia, do Curso de Odontologia da Universidade Federal do Espírito Santo. Serão usados protótipos obtidos para a pesquisa. As estruturas prototipadas serão fixadas em estruturas de alumínio-aço feitas sob medida com molas que permitem a abertura e o fechamento da mandíbula. Em cada maxila, um implante de 7 mm com uma conexão cônica interna e plataforma regular de 3,5 mm de diâmetro (TitamaxTi; Neodent) será inserida na região do incisivo central por cirurgião-dentista especialista em Implantodontia, com no mínimo 5 anos de experiência em implantes dentários.
Abutments de implante dentário feitos sob medida de 3.5 mm de diâmetro com colares de metal (UCLA Anti-Rotacional CoCr; Neodent) serão colocados e apertados a 20 N.cm. Desajustes de 50 e 150 m serão simuladas por meio da interposição de, respectivamente, 1 ou 3 tiras de poliéster com 50 m de espessura (Fita Matriz de Poliéster; TDV) no IIP. O trabalho será composto por 1 variável de resposta e 2 variáveis de agrupamento. A variável de resposta será a presença ou ausência dos desajustes nas IIP, é uma variável qualitativa ordinal com 5 níveis ("definitivamente presente", "provavelmente presente", "incerto", "provavelmente ausente" e "definitivamente ausente"). As variáveis de agrupamento serão a magnitude de desajustes simulado nas IIP (50 ou 150 m) e a técnica radiográfica.
Quatro cirurgiões-dentistas, alunos do mestrado do programa PPGCO com pelo menos 5 anos de experiência na avaliação de implantes dentários serão convidados a participar do estudo como avaliadores. Os avaliadores serão treinados previamente às avaliações, por meio da análise de várias imagens de desajustes e ajuste.
Os avaliadores não terão acesso ao padrão de referência, de maneira a não influenciar nas avaliações das imagens. Trinta dias após a avaliação, 20% das imagens serão reavaliadas para análise de reprodutibilidade intra-avaliador. As análises de reprodutibilidade intra e interavaliador

serão realizadas usando o teste Kappa ponderado.

Considerações sobre os Termos de apresentação obrigatória:
-Folha de rosto: apresentada e adequada
-Projeto detalhado: apresentado e adequado
-TCLE: apresentado e adequado
-Termo de Assentimento: não se aplica
-Termo de Sigilo e Confidencialidade: apresentado e adequado
-Termo de anuência da instituição onde a pesquisa será realizada: a pesquisadora é aluna de mestrado da UFES, não necessitando de apresentação do termo
-Cronograma: apresentado e adequado
-Orçamento: apresentado e adequado

Os termos de apresentação obrigatória estão em conformidade com a Resolução CNS 466/12.

Recomendações:
Nenhuma

Conclusões ou Pendências e Lista de Inadequações:
o projeto está de acordo com as exigências do sistema CEP/CONEP e Resolução do CNS 466 de 2012.

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1678228.pdf	28/01/2021 14:54:00		Aceito
Folha de Rosto	folhaDeRosto.pdf	28/01/2021 14:53:36	Vanessa Pacheco de Oliveira	Aceito
Outros	Fichadeavaliacao.pdf	09/12/2020 17:11:37	Vanessa Pacheco de Oliveira	Aceito
Projeto Detalhado / Brochura Investigador	Projeto.pdf	09/12/2020 17:09:38	Vanessa Pacheco de Oliveira	Aceito
TCLE / Termos de	TCLE.pdf	09/12/2020	Vanessa Pacheco de	Aceito

Assentimento / Justificativa de Ausência	TCLE.pdf	17:09:12	Oliveira	Aceito
Declaração de Pesquisadores	TermodeCompromissoeConfidencialidadeassinado.pdf	08/12/2020 17:06:23	Vanessa Pacheco de Oliveira	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

VITORIA, 09 de Março de 2021

Assinado por:
Maria Helena Monteiro de Barros Miotto
(Coordenador(a))

ANEXO B - NORMAS DA REVISTA Journal of Prosthetic Dentistry

JOURNAL OF PROSTHETIC DENTISTRY
The Official Publication for 24 Leading U.S. and International Prosthodontic Organizations

AUTHOR INFORMATION PACK

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ISSN: 0022-3913

DESCRIPTION

The Journal of Prosthetic Dentistry is the leading professional journal devoted exclusively to **prosthetic** and **restorative dentistry**. The *Journal* is the official publication for 24 leading U.S. international prosthodontic organizations. The monthly publication features timely, original peer-reviewed articles on the newest techniques, dental materials, and research findings. The *Journal* serves prosthodontists and dentists in advanced practice, and features color photos that illustrate many step-by-step procedures. *The Journal of Prosthetic Dentistry* is included in Index Medicus and CINAHL.

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Spanish: 2013 Guía para la Preparación de ManuscritosTurkish: 2013 Makale Hazırlama RehberiPortuguese: 2013 Guia para a Preparação de Manuscritos

Now in its 65th year, *The Journal of Prosthetic Dentistry* is the leading professional journal devoted exclusively to prosthetic and restorative dentistry. The Journal is the official publication of 24 leading U.S. and international prosthodontic organizations, serving prosthodontists and dentists in advanced practice. It features timely, original peer-reviewed articles on the newest techniques, dental materials, and research findings, with color photographs that illustrate step-by-step procedures. *The Journal of Prosthetic Dentistry* is included in Index Medicus and CINAHL, and is the highest ranked Prosthodontics title by number of citations according to the 2014 Journal Citation Reports.®

Article Types

Articles are classified as one of the following: research/clinical science article, clinical report, technique article, systematic review, or tip from our readers. Required sections for each type of article are listed in the order in which they should be presented.

JPD Digital

JPD Digital is an exclusive video platform from *The Journal of Prosthetic Dentistry* featuring topics on prosthodontics and implants of interest to clinicians and dental technologists. By submitting a video and summary to JPD Digital, you can allow your audience to look over your shoulder to get a close look at your work. View JPD Digital articles here: https://www.thejpd.org/video-do. Please contact the JPD Editorial Office at JPD@augusta.edu to learn more if you are interested in submitting an article for JPD Digital. All submissions to JPD Digital will be peer reviewed and subject to Editor approval.

Requirements for publication in JPD Digital include: Video 30-60 minutes in length to be reviewed and approved by the JPD Digital team A short, written summary (under 2 pages) to publish in the *Journal of Prosthetic Dentistry*, consisting of: Brief abstract Summary of video presentation 1-2 illustrations References Brief author bio

JPD Digital Recording Instructions

Research and Education/Clinical Research

The research report should be no longer than 10-12 double-spaced, typed pages and be accompanied by no more than 12 high-quality illustrations. Avoid the use of outline form (numbered and/or bulleted sentences or paragraphs). The text should be written in complete sentences and paragraph form.

Abstract (approximately 400 words): Create a structured abstract with the following subsections: Statement of Problem, Purpose, Material and Methods, Results, and Conclusions. The abstract should contain enough detail to describe the experimental design and variables. Sample size, controls, method of measurement, standardization, examiner reliability, and statistical method used with associated level of significance should be described in the Material and Methods section. Actual values should be provided in the Results section.

Clinical Implications: In 2-4 sentences, describe the impact of the study results on clinical practice.

Introduction: Explain the problem completely and accurately. Summarize relevant literature, and identify any bias in previous studies. Clearly state the objective of the study and the research hypothesis at the end of the Introduction. Please note that, for a thorough review of the literature, most (if not all references) should first be cited in the Introduction and/or Material and Methods section.

Material and Methods: In the initial paragraph, provide an overview of the experiment. Provide complete manufacturing information for all products and instruments used, either in parentheses or in a table. Describe what was measured, how it was measured, and the units of measure. List criteria for quantitative judgment. Describe the experimental design and variables, including defined criteria to control variables, standardization of testing, allocation of specimens/subjects to groups (specify method of randomization), total sample size, controls, calibration of examiners, and reliability of instruments and examiners. State how sample sizes were determined (such as with power analysis). Avoid the use of group numbers to indicate groups. Instead, use codes or abbreviations that will more clearly indicate the characteristics of the groups and will therefore be more meaningful for the reader. Statistical tests and associated significance levels should be described at the end of this section.

Results: Report the results accurately and briefly, in the same order as the testing was described in the Material and Methods section. For extensive listings, present data in tabular or graphic form to help the reader. For a 1-way ANOVA report of, F and P values in the appropriate location in the text. For all other ANOVAs, per guidelines, provide the ANOVA table(s). Describe the most significant findings and trends. Text, tables, and figures should not repeat each other. Results noted as significant must be validated by actual data and P values.

Discussion: Discuss the results of the study in relation to the hypothesis and to relevant literature. The Discussion section should begin by stating whether or not the data support rejecting the stated null hypothesis. If the results do not agree with other studies and/or with accepted opinions, state how and why the results differ. Agreement with other studies should also be stated. Identify the limitations of the present study and suggest areas for future research.

Conclusions: Concisely list conclusions that may be drawn from the research; do not simply restate the results. The conclusions must be pertinent to the objectives and justified by the data. In most situations, the conclusions are true for only the population of the experiment. All statements reported as conclusions should be accompanied by statistical analyses.

*References:*See Reference Guidelines and Sample References page.

Tables: See Table Guidelines.

Illustrations: See Figure Submission and Sample Figures page.

Clinical Report

The clinical report describes the author's methods for meeting a patient treatment challenge. It should be no longer than 4 to 5 double-spaced, pages and be accompanied by no more than 8 high-quality illustrations. In some situations, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.

Abstract: Provide a short, nonstructured, 1-paragraph abstract that briefly summarizes the problem encountered and treatment administered.

Introduction: Summarize literature relevant to the problem encountered. Include references to standard treatments and protocols. Please note that most, if not all, references should first be cited in the Introduction and/or Clinical Report section.

Clinical Report: Describe the patient, the problem with which he/she presented, and any relevant medical or dental background. Describe the various treatment options and the reasons for selection of the chosen treatment. Fully describe the treatment rendered, the length of the follow-up period, and any improvements noted as a result of treatment. This section should be written in past tense and in paragraph form.

Discussion: Comment on the advantages and disadvantages of the chosen treatment and describe any contraindications for it. If the text will only be repetitive of previous sections, omit the Discussion.

Summary: Briefly summarize the patient treatment.

References: See Reference Guidelines and Sample References page.

Illustrations: See Figure Submission and Sample Figures page.

Dental Technique

The dental technique article presents, in a step-by-step format, a unique procedure helpful to dental professionals. It should be no longer than 4 to 5 double-spaced, typed pages and be accompanied by no more than 8 high-quality illustrations. In some situations, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.

Abstract: Provide a short, nonstructured, 1-paragraph abstract that briefly summarizes the technique.

Introduction: Summarize relevant literature. Include references to standard methods and protocols. Please note that most, if not all, references should first be cited in the Introduction and/or Technique section.

Technique: In a numbered, step-by-step format, describe each step of the technique. The text should be written in command rather than descriptive form (?Survey the diagnostic cast? rather than ?The diagnostic cast is surveyed.?) Include citations for the accompanying illustrations.

Discussion: Comment on the advantages and disadvantages of the technique, indicate the situations to which it may be applied, and describe any contraindications for its use. Avoid excessive claims of effectiveness. If the text will only be repetitive of previous sections, omit the Discussion.

Summary: Briefly summarize the technique presented and its chief advantages.

References: See Reference Guidelines and Sample References page

Illustrations: See Figure Submission and Sample Figures page.

Systematic Review

The author is advised to develop a systematic review in the Cochrane style and format. The *Journal* has transitioned away from literature reviews to systematic reviews. For more information on systematic reviews, please see www.cochrane.org. An example of a Journal systematic review: Torabinejad M, Anderson P, Bader J, Brown LJ, Chen LH, Goodacre CJ, Kattadiyil MT, Kutsenko D, Lozada J, Patel R, Petersen F, Puterman I, White SN. Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: a systematic review. J Prosthet Dent 2007;98:285-311.

The systematic review consists of:

An Abstract using a structured format (Statement of Problem, Purpose, Material and Methods, Results, Conclusions).

Text of the review consisting of an introduction (background and objective), methods (selection criteria, search methods, data collection and data analysis), results (description of studies, methodological quality, and results of analyses), discussion, authors' conclusions, acknowledgments, and conflicts of interest. References should be peer reviewed and follow JPD format.

Tables and figures, if necessary, showing characteristics of the included studies, specification of the interventions that were compared, the results of the included studies, a log of the studies that were excluded, and additional tables and figures relevant to the review.

Tips From Our Readers

Tips are brief reports on helpful or timesaving procedures. They should be limited to 2 authors, no longer than 250 words, and include no more than 2 high quality illustrations. Describe the procedure in a numbered, step-by-step format; write the text in command rather than descriptive or passive form ("Survey the diagnostic cast" rather than "The diagnostic cast is surveyed").

Contact Information

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BEFORE YOU BEGIN

Submission Guidelines

Thank you for your interest in writing an article for *The Journal of Prosthetic Dentistry*. In publishing, as in dentistry, precise procedures are essential. Your attention to and compliance with the following policies will help ensure the timely processing of your submission.

Length of Manuscripts

Manuscript length depends on manuscript type. In general, research and clinical science articles should not exceed 10 to 12 double-spaced, typed pages (excluding references, legends, and tables). Clinical Reports and Technique articles should not exceed 4 to 5 pages, and Tips articles should not exceed 1 to 2 pages. The length of systematic reviews varies.

Number of Authors

The number of authors is limited to 4; the inclusion of more than 4 *must be justified* in the letter of submission. (Each author's contribution must be listed.) Otherwise, contributing authors in excess of 4 will be listed in the Acknowledgments. There can only be one corresponding author.

General Formatting

All submissions must be submitted via the Editorial Manager system in Microsoft Word with an 8.5×11 inch page size. The following specifications should also be followed:
Times Roman, 12 ptDouble-spacedLeft-justifiedNo space between paragraphs1-inch margins on all sidesHalf-inch paragraph indentsHeaders/Footers should be clear of page numbers or other informationHeadings are upper case bold, and subheads are upper/lower case bold. No italics are used.References should not be automatically numbered. Endnote or other reference-generating programs should be turned off.Set the Language feature in MS Word to English (US). Also change the language to English (US) in the style named Balloon Text.

Ethics in publishing

Please see our information on Ethics in publishing.

Informed consent and patient details

Studies on patients or volunteers require ethics committee approval and informed consent, which should be documented in the paper. Appropriate consents, permissions and releases must be obtained where an author wishes to include case details or other personal information or images of patients and any other individuals in an Elsevier publication. Written consents must be retained by the author but copies should not be provided to the journal. Only if specifically requested by the journal in exceptional circumstances (for example if a legal issue arises) the author must provide copies of the consents or evidence that such consents have been obtained. For more information, please review the Elsevier Policy on the Use of Images or Personal Information of Patients or other Individuals. Unless you have written permission from the patient (or, where applicable, the next of kin), the personal details of any patient included in any part of the article and in any supplementary materials (including all illustrations and videos) must be removed before submission.

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Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify compliance, your article may be checked by Crossref Similarity Check and other originality or duplicate checking software.

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Author contributions

For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example.

Changes to authorship

Authors are expected to consider carefully the list and order of authors **before** submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only **before** the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the **corresponding author**: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed.
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It is important that the file be saved in the native format of the MS Word program. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier: https://www.elsevier.com/guidepublication). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

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Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, it is recommended to include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Artwork

Figure Submission

JPD takes pride in publishing only the highest quality figures in its journal. All incoming figures must pass a thorough examination in Photoshop before the review process can begin. With more than 1,000 manuscripts submitted yearly, the manuscripts with few to no submission errors move through the system quickly. Figures that do not meet the guidelines will be sent back to the author for correction and moved to the bottom of the queue, creating a delay in the publishing process.

File Format
All figures should be submitted as TIF files or JPEG files only.

Image File Specifications

Figure dimensions must be 5.75 × 3.85 inches.
Figures should be size-matched (the same physical size) unless the image type prohibits size matching to other figures within the manuscript, as in the case of panoramic or periapical radiographs, SEM images, or graphs and screen shots. Do not "label" the faces of the figures with letters or numbers to indicate the order in which the figures should appear; such labels will be inserted during the publication process. Do not add wide borders to increase size.

Resolution
The figures should be of professional quality and high resolution. The following are resolution requirements:
Color and black-and-white photographs should be created and saved at 300 dots per inch (dpi).
Note: A 5.75 × 3.85-inch image at a resolution of 300 dpi will be approximately 6 megabytes. A figure of less than 300 dpi must not be increased artificially to 300 dpi; the resulting quality and resolution will be poor.
Line art or combination artwork (an illustration containing both line art and photograph) should be created and saved at a minimum of 600dpi.Clarity, contrast, and quality should be uniform among the parts of a multipart figure and among all of the figures within a manuscript.A uniform background of nontextured, medium blue should be provided for color figures when possible.

Text within Images

If text is to appear within the figure, labeled and unlabeled versions of the figures must be provided. Text appearing within the labeled versions of the figures should be in **Arial font and a minimum of 10 pt.** The text should be sized for readability if the figure is reduced for production in the Journal. Lettering should be in proportion to the drawing, graph, or photograph. A consistent font size should be used throughout each figure, and for all figures, Please note: Titles and captions should not appear within the figure file, but should be provided in the manuscript text (see Figure Legends).

If a key to an illustration requires artwork (screen lines, dots, unusual symbols), the key should be incorporated into the drawing instead of included in the typed legend. All symbols should be done professionally, be visible against the background, and be of legible proportion should the illustration be reduced for publication.

All microscopic photographs must have a measurement bar and unit of measurement on the image.

Color Figures

Generally, a maximum of 8 figures will be accepted for clinical report and dental technique articles, and 2 figures will be accepted for tips from our reader articles. However, the Editor may approve the publication of additional figures if they contribute significantly to the manuscript.
Clinical figures should be color balanced. Color images should be in CMYK (Cyan/Magenta/Yellow/Black) color format as opposed to RGB (Red/Green/Blue) color format.

Graphs/Screen Captures

Graphs should be numbered as figures, and the fill for bar graphs should be distinctive and solid; no shading or patterns. Thick, solid lines should be used and bold, solid lettering. Arial font is preferred. Place lettering on white background is preferred to reverse type (white lettering on a dark background). Line drawing should be a minimum of 600 dpi. Screen Captures should be a minimum of 300 dpi and as close to 5.75 and 3.85 as possible.
Composites

Composites are multiple images within one Figure file and, as a rule, are not accepted. They will be sent back to the author to replace them with each image sent separately as, Fig. 1A, Fig. 1B, Fig. 1C, etc. Each figure part must meet JPD Guidelines. (Some composite figures are more effective when submitted as one file. These files will be reviewed per case.) Contact the editorial office for more information about specific composites.

Figure Legends

The figure legends should appear within the text of the manuscript on a separate page after Tables and should appear under the heading FIGURES. Journal style requires that the articles (a, an, and the) are omitted from the figure legends. If an illustration is taken from previously published material, the legend must give full credit to the source (see Permissions).

File Naming

Each figure file must be numbered according to its position in the text (Figure 1, Figure 2, and so on) with Arabic numerals. The electronic image files must be named so that the figure number and format can be easily identified. For example, a Figure 1 in TIFF format should be named fig. 1.tif. Multipart figures must be clearly identifiable by the file names: Fig. 1A, Fig. 1B, Fig. 1C, Fig. 1-unlabeled, Fig. 1-labeled, etc.

Callouts

In the article, clearly reference each Figure and Table by including its number in parentheses at the end of the appropriate sentence before closing punctuation. For example: The sutures were removed after 3 weeks (Fig. 4). Or: are illustrated in Table 4.
The *Journal* reserves the right to standardize the format of graphs and tables.
Authors are obligated to disclose whether illustrations have been modified in any way.

Thumbnails

Place thumbnails (reduced size versions) of your figures in Figures section below each appropriate legend.
Thumbnails refers to placing a small (compressed file) copy of your figure into the FIGURES section of the manuscript after each appropriate legend. No smaller than 2" × 1.5" and approximately 72dpi. The goal is to give the editors/reviewers something to review but we want to keep the dimensions and the file size small for easy access. These small images are called thumbnails.

Figures Quick Checklist

All files are saved as TIFFs or JPEGs (only).Figure size: 5.75" × 3.85" (radiographs, SEMS, and screen captures may vary but they must all be size-matched). Figures are 300 dpi; line or combo line/photo illustrations are minimum 600 dpi.For text in figures use Ariel font.Label the Figure files according to their sequence in the text.Provide figure legends in the manuscript Figure section.Place thumbnails (small versions of figure files approx. 2" × 1.5") in Figure section below each legend.Submit composite figure parts as separate files.
A detailed guide to electronic artwork is available on our website: You are urged to visit this site; some excerpts from the detailed information about figure preparation are given here. https://www.elsevier.com/artworkinstructions.
Please make sure that artwork files are TIFFs and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) in addition to color reproduction in print. For further information on the preparation of electronic artwork, please see https://www.elsevier.com/artworkinstructions.

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• Use a logical naming convention for your artwork files.
• Provide figure legends in the Figure section.
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Acceptable references and their placement
Most, if not all, references should first be cited in the Introduction and/or Material and Methods section. Only those references that have been previously cited or that relate directly to the outcomes of the present study may be cited in the Discussion.

Only peer-reviewed, published material may be cited as a reference. Manuscripts in preparation, manuscripts submitted for consideration, and unpublished theses are not acceptable references.

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Reference formatting should conform to **Vancouver style** as set forth in "Uniform Requirements for Manuscripts Submitted to Biomedical Journals" (Ann Intern Med 1997;126:36-47).

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List up to six authors. If there are seven or more, after the sixth author's name, add et al.

Abbreviate journal names per the **Cumulative Index Medicus**. A complete list of standard abbreviations is available through the PubMed website: http://www.ncbi.nlm.nih.gov/nlmcatalog/journals.

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Ex: Jones ER, Smith IM, Doe JQ. Uses of acrylic resin. J Prosthet Dent 1985;53:120-9.

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All figure thumbnails and legends All tables (including title, description, footnotes) Justification letter for more than 4 authors Patient photo permission IRB statements

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Authors whose native language is not English should obtain the assistance of an expert in English and scientific writing before submitting their manuscripts. Manuscripts that do not meet basic language standards will be returned before review.The Journal does not use first person (I, we, us, our, etc.). "We conducted the study" can be changed easily to "The study was conducted." Avoid the use of subjective terms such as "extremely", "innovative" etc. The JPD uses the serial comma which is the comma that precedes the conjunction before the final item in a list of three or more items: The tooth was prepared with a diamond rotary instrument, carbide bur, and carbide finishing bur. We prefer the nonpossessive form for eponyms: the Tukey HSD test rather than Tukey's HSD test, Down syndrome rather than Down's syndrome and so on.Describe experimental procedures, treatments, and results in passive tense. All else should be written in an active voice. Describe teeth by name (eg, maxillary right first molar), not number. Hyphens are not used for common suffixes and prefixes, unless their use is critical to understanding the word. Some prefixes with which we do not use hyphens include: pre-, non-, anti-, multi-, auto-, inter-, intra-, peri-.Eliminate the use of i.e. and e.g. as they are not consistent with Journal style. Spell out seconds, minutes, hours, etc.Only use abbreviations in the Tables.Avoid the repeated use of Product names in the manuscript. Please initially identify all the products used in the experiment and subsequently refer to them by generic terms.It is generally better to paraphrase information from a published source than to use direct quotations. Paraphrasing saves space. The exception is a direct quotation that is unusually pointed and concise. When long terms with standard abbreviations (as in TMJ for *temporomandibular joint*) are used frequently, spell out the full term upon first use and provide the abbreviation in parentheses. Use only the abbreviation thereafter. Even very common acronyms should still be defined at first mention. We do not italicize foreign words such as "in vivo", "in vitro." Abbreviate units of measurement without a period in the text and tables (9 mm). Insert a nonbreaking space between all numbers and their units (100 mm, 25 MPa) except before % and °C. There should never be a hyphen between the number and the abbreviation or symbol except when in adjectival form (100-mm span). Spell out "degrees" for angles. Use the degree symbol only for temperature, include a space between the number and degree symbol (e.g., 37 C). Contractions such as don't, it's, wouldn't, etc are not used in scientific writing.Avoid using the words ""respectively"" or ""former/latter."" Both force the reader to stop and backtrack.For the common statistical outcomes P, a, ß omit the zero before the decimal point as these cannot be greater than 1. Proprietary names function as adjectives. Nouns must be supplied after their use, as in *Vaseline petroleum jelly*. Wherever possible, use only the generic term. Do not use trademark symbols as they are not consistent with Journal style.

Some Elements of Effective Style

Short words. Short words are preferable to long ones if shorter word is equally precise.Familiar words. Readers want information that they can grasp easily and quickly. Simple, familiar words provide clarity and impact. Specific rather than general words. Specific terms pinpoint meaning and create word pictures; general terms may be fuzzy and open to varied interpretations. Brisk opening. Plunge into your subject in the first paragraph of the article. Limited use of modifying words and phrases. Check your adjectives, adverbs, and prepositional phrases. If they are not needed, strike them out. No unnecessary repetition. An idea may be repeated for emphasis—so long as that repetition is effective. Short sentence length. Twenty words or less is recommended. Rambling sentences cluttered with subordinate clauses and other modifiers are hard to read and may cause readers to lose their train of thought. Short sentences should, however, be balanced with somewhat longer ones to avoid monotony. Paragraphs. Break up long sections into paragraphs but avoid the use of single sentence paragraphs. Restraint. Writers who use flamboyant words or overstate their proposition or conclusions discredit themselves. Facts speak for themselves. Clearly stated conclusions. Don't hedge. If you don't know something, say so.

Objectionable Terms

The following are selected objectionable terms and their proper substitutes. For a complete list of approved prosthodontic terminology, consult the eighth edition of the *Glossary of Prosthodontic Terms* (J Prosthet Dent 2005;94:10-92).

Or visit JPD http://www.prosdent.org and click on Collections/Glossary of Prosthodontic Terms.

Alginate *use* Irreversible hydrocolloidBite *use* OcclusionBridge *use* Partial fixed dental prosthesisCase *use* Patient, situation, or treatment as appropriateCure *use* PolymerizeFinal *use* DefinitiveFreeway space *use* Interocclusal distanceFull denture *use* Complete dentureLower (teeth, arch) *use* MandibularModel *use* CastModeling compound *use* Modeling plastic impression compoundMuscle trimming *use* Border moldingOverbite, overjet *use* Vertical overlap, horizontal overlapPeriphery *use* BorderPost dam, postpalatal seal *use* Posterior palatal sealPrematurity *use* Interceptive occlusal contactSaddle *use* Denture baseStudy model *use* Diagnostic castTake impressions, photographs, radiographs *use* MakeUpper (teeth, arch) *use* MaxillaryX-ray, roentgenogram *use* Radiograph

In addition, *specimen* should be used rather than *sample* when referring to an example regarded as typical of its class.

Additional Terminology Guidelines

Acrylic
An adjective form that requires a noun, as in acrylic resin.

Affect, effect
Affect is a verb; effect is a noun.

African American
Spelled thus and preferred over Negro and black in both adjective (African American patients) and noun (... of whom 20% were African Americans) forms.

Average, mean, median
Mean and average are synonyms. Median refers to the midpoint in a range of items; the midpoint has many items above as below it.

Basic
Like fundamental, this word is often unnecessary. An example of unnecessary use: Dental implants consist of two basic types: subperiosteal and endosteal.

Between, among
Use between when 2 things are involved and among when there are more than 2.

Biopsy
This noun should NOT be used as a verb. A biopsy was performed on the Tissue, rather than: The tissue was biopsied.

Centric
An adjective that requires a noun, as in centric relation.

Currently, now, at present, etc.
These expressions are often unnecessary, as in: This technique is currently being used...

Data
Use as a plural, as in: The data were...

Employ
Should not become an elegant variation of use, as in This method is employed ...

Ensure
Preferred over insure in the sense of to make certain.

Fewer, less
Use fewer with nouns that can be counted (fewer patients were seen) and less with nouns that cannot be counted (less material was used).

Following
After is preferred.

Imply, infer
The speaker implies; the listener infers.

Incidence

The rate at which a disease occurs in a given time; sometimes confused with prevalence (the total number of cases of a disease in a given region).

Majority
Means more than half; use most when you mean almost all. **Male, female**
For adult humans, use men and women. For children, use boys and girls.

Must, should
Must means that the course of action is essential. Should is less strong and means that the course of action is recommended.

Numbers
Spell out numbers used in titles or headings and numbers at the beginning of a sentence. The spelled version may also be preferable in a series of consecutive numbers that may confuse the reader (eg, 2 3.5-inch disks should be written two 3.5-inch disks). In all other cases, use Arabic numerals.

Orient
Proper form; avoid orientate.

Pathologic
Use instead of pathological. Other words in which the suffix -al has been dropped include biologic, histologic, and physiologic.

Pathology
The study of disease; often mistaken for pathosis (the condition of disease)

Percent
Use the percent sign in the text, as in The distribution of scores was as follows: adequate, 8%; oversized, 23%; and undersized, 69%. But spell out when the percent opens a sentence, as in Twenty percent of the castings ...

Prior to
Before is preferred.

Rare, infrequent, often not, etc.
Whenever possible, these vague terms should be backed up with a specific number.

Rather
Like very, this word should be avoided.

Regimen
A planned program for taking medication, dieting, exercising, etc. Not to be confused with regime, meaning a system of government or management.

Sex
Use "sex" rather than "gender" unless you are referring to the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women.

Symptomatology
The science or study of symptoms; this word is not a synonym for the word symptoms.

Technique
Preferred over technic.

Using
Avoid the dangling modifier in sentences such as "The impression was made using vinyl polysiloxane impression material." Write "with" or "by using" instead.

Utilize
Use is preferred.

Vertical
An adjective that needs a noun, as in vertical relation.

Via
Use through, with, or by means of.

White
Preferred over Caucasian. This is true only if the patient is from the Caucasus region of Eastern Europe. If not, use the term, white to describe the patient.

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ANEXO C - ARTIGO EM INGLÊS

Detection of misfits at the abutment-prosthesis interface in the esthetic region: implications of the radiographic technique and the magnitude of the misfit

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CLINICAL RESEARCH

Detection of misfits at the abutment-prosthesis interface in the aesthetic zone: implications of the radiographic technique and the magnitude of the misfit

ABSTRACT

Statement of problem. Misfits in the abutment-prosthesis interface represent a setback for rehabilitation treatment with dental implants. Periapical radiographs are used as an auxiliary method in the evaluation of prostheses fitting over abutments, however, the evidence supporting the use of this method is still restricted to studies of low to moderate quality. Furthermore, the literature lacks studies regarding the diagnostic accuracy of different periapical techniques clinically used to detect misfits in the abutment-prosthesis interface, especially in the aesthetic zone.

Purpose. To assess the diagnostic accuracy of 3 periapical radiographic techniques in detecting misfits at the abutment-prosthesis interface in the aesthetic zone and to evaluate whether the misfits' magnitude influences the diagnosis.

Material and methods. A total of 15 implants with an internal conical connection were installed in the central incisor region in polyamide jaws. Customized ceramic copings for cemented crowns were made using a CAD-CAM system. Misfits of 50, 100, and 150 µm were simulated by interposing 1, 2, or 3 50-µm-thick polyester strips at the abutment-prosthesis interface, respectively; the absence of the strip represented the control group. Digital radiographs were obtained using film holders for the following periapical techniques: bisecting angle (PBA), standard paralleling (PSP), and modified paralleling (PMP). 2 radiologists and 1 prosthodontist evaluated a total of 180 radiographs. The values of the area under the receiver operating characteristic curve (Az) were subjected to the Friedman test with post hoc Durbin-Conover ($\alpha = 5\%$).

Results: The PSP (Az = 0.873) had higher Az values than the PBA (Az = 0.753) for the 50-µm misfits ($p < 0.05$). Bigger misfits resulted in greater accuracy than smaller misfits ($p < 0.05$). Interactions between the factors radiographic technique and misfits' magnitude resulted in statistically significant differences for all comparisons ($p < 0.05$), except that between the PSP for the 100-µm misfits (Az = 0.976) and the PMP for the 150-µm misfits (Az = 0.998).

Conclusions. The PSP was more accurate than the PBA to detect the 50-µm misfits at the abutment-prosthesis interface; bigger misfits resulted in more accurate diagnoses regardless of the technique used.

CLINICAL IMPLICATIONS

The literature still lacks a well-established protocol to assess prosthesis fitting over abutments, especially in implants with an internal conical connection located in the aesthetic zone. Our findings showed that the periapical technique with standard paralleling is more adequate to detect small misfits, whose diagnosis is more challenging compared with bigger misfits.

INTRODUCTION

Misfits at the abutment-prosthesis interface represent a setback for rehabilitation treatment with dental implants[1-4], which may increase undesirable tensions and contribute to the establishment of peri-implant diseases.[2,5-8] Although a biological tolerance of 100-μm misfits is accepted for passive fitting,[5-6] there is no consensus on the acceptable magnitude of misfits,[9] even though values such as 50 μm and 120 μm have already been reported.[10-11] Moreover, the literature lacks consensus regarding which method of retaining the prosthesis over the abutment (i.e.; screw fixation or cementation) has greater longevity.[7] Even though residues from cement excess may compromise osseointegration,[7,12-14] cemented prostheses are indicated for the aesthetic zone.[5,15]

Although the prosthetic structures are usually overlapped due to the geometric projection typical of intraoral radiographs,[16-17] these are considered more accurate than cone beam computed tomography for the detection of misfits in prosthetic crowns.[18] Therefore, intraoral radiographs are the standard complementary method of choice for such purpose,[19-20] as well as to assess residual cement excess in prostheses over implants.[21] Compared to film-based, digital radiographs are preferred to assess misfits at the implant-abutment interface,[22-23] especially those obtained with photostimulable phosphor plate systems, regardless of the visualization software and enhancement filters used.[23-24]

The selection of the radiographic technique plays an important role in the assessment of misfits.[19-20] The technique of periapical with standard paralleling (PSP) is referred to as the most accurate for detecting misfits, particularly when compared to the periapical with bisecting angle (PBA), due to a more orthogonal projection of structures in the PSP.[25-26] The projection angle plays an important role in the accuracy of detection since vertical angulations greater than 15° may impair even the detection of larger misfits, which are regarded as more easily seen than smaller ones.[16,19-20,22,25-27]

Despite the existing literature on the radiographic diagnosis of misfits in prostheses over implants, the supporting evidence was considered to be of low to moderate quality according to the criteria of Quality Assessment of Diagnostic Accuracy Studies (QUADAS).[25] In addition, the authors are unaware of studies regarding radiographic detection of misfits at the abutment-prosthesis interface in the aesthetic zone, where implants with an internal conical connection are more common. Thus, due to the lack of a systematic and effective protocol, this study aimed to assess the diagnostic accuracy of 3 periapical techniques (the PBA, the PSP, and the modified paralleling technique (PMP)) in detecting misfits at the abutment-prosthesis interface on implants with an internal conical connection in the aesthetic zone. Furthermore, this study also aimed to investigate whether misfits' magnitude influences the diagnostic accuracy of the studied techniques under simulated clinical conditions in which the X-ray vertical angle is mostly above 15°. The null hypotheses were that the radiographic techniques and the magnitudes would not affect the accuracy of misfit detection.

MATERIAL AND METHODS

This in vitro study was approved by the local Ethics Research Committee (CAAE 42616720.3.0000.5060). A total of 15 prototypes of mandibles and maxillae obtained from cone beam computed tomography scans were used, according to a methodology previously reported.[26] In each maxilla, an 11.5-mm implant with an internal conical connection and regular Ø4.5-mm platform (Tryon Morse; S.I.N. Implant System) was inserted in the region of the upper left central incisor by an experienced dental implantologist (i.e., >10 years of clinical experience). The implants were installed with the shoulder at the level of the alveolar bone crest, following the protocol recommended by the manufacturer. In the other regions, normal intact dentition was maintained. The sample size was calculated for Receiver Operating Characteristics Curves (ROC) comparisons, estimating an area under the ROC curve (Az) of 0.7, with an alpha of 5%, beta of 20%, and a control/misfit implant ratio of 1 (MedCalc software program; MedCalc), based on parameters from previous studies.[17,20,26-27]

Prefabricated Ø4.5-mm abutments (Tryon Morse; S.I.N. Implant System) were placed and tightened at 20 N.cm. Customized ceramic copings were made using a CAD-CAM system (Amann; Ceramill® Motion 2). Misfits were simulated by inserting 50-µm-thick polyester strips (Polyester Matrix Tape; TDV Dental) at the abutment-prosthesis interface. A Ø4.5-mm circular hole was made in the center of each polyester strip to ensure uniform contact between the abutment surface and the lower surface of the coping. One (50-µm misfits), 2 (100-µm misfits), and 3 polyester strips (150-µm misfits) were inserted at the abutment-prosthesis interface. To ensure adhesion between the pieces, the coping was internally filled with 0.02 ml of polyvinyl siloxane (Speedex Light Body; Coltene). The amounts of paste and catalyst were used according to the manufacturer's instructions. The coping was brought into position over the abutment by applying digital pressure for 6 minutes. After this time, radiographs were taken. In the control group (no simulated misfit), the coping was installed directly over the abutment; this group was examined using scanning electron microscopy to ensure a reference standard (JSL-6610LV; Jeol) (Figure 1).

A single trained operator (V.P.O.M.) radiographed the implants using film holders for the PBA (Cone Indicator; Indusbello) and the PSP (Rinn-XCP; Dentsply Sirona), while a guide for parallelism was custom-made for PMP, as described by Lin et al. (2014) (Figure 2).[28] For each radiographic exposure, the prototypes were positioned with the Frankfurt plane parallel to the horizontal plane to allow the measurement of the X-ray vertical angle used. The radiographs were made by using phosphor plates (31 × 41 mm; VistaScan Mini Easy; Dürr Dental) and the same X-ray device (Focus™; Kavo) preset at 70 kVp, 7 mA, and 0.1 seconds. Occlusal registrations were made by using polyvinyl siloxane (Speedex Putty; Coltene) to standardize the radiographic exposures among the simulated misfit magnitudes. A total of 180 radiographs were obtained, considering 3 radiographic techniques (PBA, PSP, and PMP) and 4 misfit conditions (control, 50 µm, 100 µm, and 150 µm). Figure 3 shows examples of radiographs obtained in the study.

A total of 3 professionals were trained for image assessment, 1 prosthodontist and 2 oral radiologists with at least 5 years of experience in their areas. Training sessions included radiographs of misfitted and control prostheses not included in the study. Image assessment took place in a silent dim-light room, using a 21.5-inch LED monitor (SE2222H; Dell) and the Windows Image Viewer software program (Microsoft Corp); using the zoom tool was allowed. The observers did not have access to the reference standard, aiming not to influence the image evaluations. The responses regarding misfit presence/absence at the abutment-prosthesis interface could be “definitely present,” “probably present,” “uncertain,” “probably absent,” and “definitely absent.”

Thirty days after the evaluation, 20% of the images were re-evaluated for intraobserver and interobserver reproducibility analyses using the weighted Kappa test.[29] A descriptive analysis of the Az values representing the ROC curves was conducted. The ROC curves were plotted based on the observers’ responses on a 5-point scale, in which each score means a cut-off point on the graph. Since the Az values had a non-parametric distribution ($W = 0.808$; $p < 0.01$), they were subjected to the non-parametric version of ANOVA for repeated measures (Friedman) with post hoc Durbin-Conover at a 5% significance level.

RESULTS

Intraobserver and interobserver reproducibility ranged from moderate to almost perfect and moderate to substantial, respectively (Table 1).[29]

Table 2 shows a descriptive analysis of the Az values. Considering the 50-µm misfits, the PSP (0.873) had higher median values than the PMP (0.824) and the PBA (0.753). The same pattern is observed for 100-µm misfits (PSP = 0.976, PMP = 0.971, and PBA = 0.956).

The 3 techniques had Az values close to or equal to 1.000 for the 150-µm misfits (PMP = 0.998, PSP = 1.000, and PBA = 1.000). Figure 4 shows the ROC curves generated.

Az values showed statistically significant differences ($\chi^2 = 22.0$; $p < 0.05$). Table 3 shows the results from post hoc Durbin-Conover, in which all comparisons with statistically significant differences are bold-highlighted ($p < 0.05$). Considering the factor “technique”, only the comparison between the PSP (Az = 0.873) and the PBA (Az = 0.753) for 50-µm misfits showed a statistically significant difference ($p < 0.05$), with the PSP being more accurate. All comparisons were statistically significant for the factor “magnitude” ($p < 0.05$); larger magnitudes showed greater accuracy compared with smaller magnitudes. The interaction between the factors “technique” and “magnitude” showed statistically significant differences for all comparisons ($p < 0.05$), except for that between the PSP for 100-µm misfits (Az = 0.976) and the PMP for 150-µm misfits (Az = 0.998), given that the Az values were similar. Larger magnitudes influenced greater accuracies in the analysis of the interactions.

Table 4 shows the median, minimum, and maximum values for the X-ray vertical angles used during radiographic exposures. The median value for the PBA (42.5º) was higher than for the PSP (32.5º) and the PMP (30º).

DISCUSSION

The data collected in this study allowed the rejection of the null hypothesis since differences among both the radiographic techniques and misfits’ magnitudes were found for misfit detection at the abutment-prosthesis interface. Although the authors are unaware of studies comparing periapical techniques for detecting misfits at the abutment-prosthesis interface, the findings regarding the 50-µm misfits corroborate previous studies that evaluated the implant-abutment interface, in which the PSP (orthogonal technique) showed greater accuracy than the PBA (non-orthogonal technique).[20,25-27] In a historical review addressing radiographic film holders,[30] the PBA film holder developed by Updegrave[31] was related to inevitable dimensional distortions, which could hinder interpretation and negatively affect the diagnostic accuracy associated with its radiographs. Conversely, the PSP film holder[32] was recommended as preferable for producing high-quality radiographs.

When the same magnitudes were considered, no statistically significant differences between the PMP and the PSP were found, corroborating a previous study.[26] Other authors[28] concluded that the PMP was more accurate than the PSP for 50 and 100-μm misfits. The different results found herein may be justified by the fact that the PMP device was developed for implants installed in the posterior region, whereas in this study the technique was adapted for the anterior region. Also, the Az values for the PBA showed no statistically significant differences when compared with those provided by the PMP for 50-μm misfits. Regarding the magnitude factor, larger misfits were more accurately detected than smaller ones, which corroborates findings from previous studies.[16,19,22,25-27] The interactions between the factors technique and magnitude showed that magnitude greatly influenced the results, considering that all comparisons but one resulted in statistically significant differences. This showed that greater magnitudes favored greater accuracy regardless of the technique used. It is noteworthy that only the comparison between the PSP for 100-μm misfits (Az = 0.976) and the PMP for 150-μm misfits (Az = 0.998) failed to show statistically significant differences.

Studies suggest that X-ray vertical angulations greater than 15° would not allow an adequate evaluation, regardless of the misfit magnitude.[16,20,27] In this study, however, misfits of different magnitudes were detected at median angulations from 30º to 42.5º with clinically acceptable accuracy (median Az values ranging from 0.753 to 1.000). Such different results may be attributed to the different designs employed, since previous studies[16,20,27] did not use radiographic film holders, but instead varied the vertical angulation in a laboratory setting, which did not necessarily reproduce a clinical scenario. Still, the PBA had the highest X-ray vertical angulation in relation to the PSP and the PMP, even using film holders.

Digital radiography was used in this study because it is the diagnostic method of choice to evaluate misfits in the implant-abutment interface when compared with film-based radiographs.[22-23] Different from a previous study,[22] a photostimulable phosphor plate system was used since it positively influences the diagnostic accuracy for detecting misfits at the implant-prosthesis interface.[23] Likewise, the Windows Image Viewer software program was used for image assessment because a previous study showed no differences between this program and those provided by the radiographic system.[23] The use of image filters was not allowed to avoid the introduction of another variable, although its application showed no significant influence on the diagnostic accuracy of misfit detection at the implant-prosthesis interface in a previous study.[24]

Although this study aimed to assess the accuracy of periapical radiographic techniques for misfit detection at the abutment-prosthesis interface, other authors[21] analyzed the use of intraoral radiographs to detect cement excess at the abutment-prosthesis interface. Nonetheless, these authors did not evaluate the influence of the magnitude of this excess. According to rule #8 of the New American Dental Association Specification, the cementation thickness must reach a maximum of 25 μm, which is contested by some authors, who consider 50 to 100 μm more appropriate.[33] Considering that there is a demand for diagnostic protocols for this purpose, future diagnostic studies should evaluate the influence of the magnitude of cement excess, seeking further clarification on the subject.

One limitation of our study is that we chose not to evaluate the lower anterior region due to the absence of tongue and adjacent musculature in the prototype, which would result in a radiographic positioning unfaithful to the clinical situation. Another limitation is that the prototypes cannot reproduce the radiographic bone density. Nonetheless, from an ethical point of view, the study design is unfeasible to be conducted with patients because they should not be subjected to unnecessary radiation exposure.

CONCLUSIONS

Based on the findings of this in vitro study, the following conclusions were drawn:

1) The PSP was more accurate than the PBA to detect misfits of 50 μm at the abutment-prosthesis interface.

2) Larger misfits showed more accurate diagnoses regardless of the technique used.

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TABLES

Table 1. Weighted kappa values for intraobserver and interobserver reproducibility.

	Radiographic Technique		
Intraobserver	**PBA**	**PSP**	**PMP**
Minimum	0,550	0,584	0,659
Maximum	0,674	0,871	0,868
Median	0,593	0,685	0,700
Interobserver			
Minimum	0,674	0,676	0,591
Maximum	0,716	0,772	0,662
Median	0,674	0,716	0.64

PBA, Periapical with bisecting angle technique. PSP, Periapical with standard paralleling technique.

PMP, Periapical with modified paralleling technique.

Table 2. Descriptive analysis of the Az values.

Group	Median	Interquartile deviation	Minimum	Maximum
PBA-50	0.753	0.015	0.753	0.784
PBA-100	0.956	0.023	0.940	0.987
PBA-150	1.000	0.016	0.967	1.000
PSP-50	0.873	0.050	0.822	0.922
PSP-100	0.976	0.022	0.940	0.984
PSP-150	1.000	0.000	1.000	1.000
PMP-50	0.824	0.032	0.807	0.871
PMP-100	0.971	0.008	0.962	0.978
PMP-150	0.998	0.016	0.967	1.000
All	0.967	0.120	0.753	1.000

PBA-50, Periapical with bisecting angle technique; 50-µm misfits. PBA-100, Periapical with bisecting angle technique; 100-µm misfits. E, 50-µm misfits. PBA-150, Periapical with bisecting angle technique; 150-µm misfits. Periapical with standard paralleling technique. PSP-50, Periapical with standard paralleling technique; 50-µm misfits. PSP-100, Periapical with standard paralleling technique; 100-µm misfits. PSP-150, Periapical with standard paralleling technique; 150-µm misfits. PMP-50, Periapical with modified paralleling technique; 50-µm misfits. PMP-100, Periapical with modified paralleling technique; 100-µm misfits. PMP-150, Periapical with modified paralleling technique; 150-µm misfits. All, Interpolation of all techniques and misfits' magnitude gathered.

Table 3. Results from the multiple comparison test (post hoc Durbin-Conover).

Comparison	Statistic	p	Factor under study
PBA-50 x PBA-100	**4.717**	**< .001**	**Magnitude**
PBA-50 x PBA-150	**8.577**	**< .001**	**Magnitude**
PBA-50 x PSP-50	**2.573**	**0.020**	**Technique**
PBA-50 x PSP-100	**6.433**	**< .001**	**Technique × Magnitude**
PBA-50 x PSP-150	**9.649**	**< .001**	**Technique × Magnitude**
PBA-50 x PMP-50	1.287	0.217	Technique
PBA-50 x PMP-100	**5.146**	**< .001**	**Technique × Magnitude**
PBA-50 x PMP-150	**7.934**	**< .001**	**Technique × Magnitude**
PSP-50 x PBA-100	**2.144**	**0.048**	**Technique × Magnitude**
PSP-50 x PBA-150	**6.004**	**< .001**	**Technique × Magnitude**
PSP-50 x PSP-100	**3.860**	**0.001**	**Magnitude**
PSP-50 x PSP-150	**7.076**	**< .001**	**Magnitude**
PSP-50 x PMP-50	1.287	0.217	Technique
PSP-50 x PMP-100	**2.573**	**0.020**	**Technique × Magnitude**
PSP-50 x PMP-150	**5.361**	**< .001**	**Technique × Magnitude**
PMP-50 x PBA-100	**3.431**	**0.003**	**Technique × Magnitude**
PMP-50 x PBA-150	**7.290**	**< .001**	**Technique × Magnitude**
PMP-50 x PSP-100	**5.146**	**< .001**	**Technique × Magnitude**
PMP-50 x PSP-150	**8.362**	**< .001**	**Technique × Magnitude**
PMP-50 x PMP-100	**3.860**	**0.001**	**Magnitude**
PMP-50 x PMP-150	**6.647**	**< .001**	**Magnitude**
PBA-100 x PBA-150	**3.860**	**0.001**	**Magnitude**
PBA-100 x PSP-100	1.715	0.106	Technique

PBA-100 x PSP-150	**4.932**	**< .001**	**Technique × Magnitude**
PBA-100 x PMP-100	0.429	0.674	Technique
PBA-100 x PMP-150	**3.216**	**0.005**	**Technique × Magnitude**
PSP-100 x PBA-150	**2.144**	**0.048**	**Technique × Magnitude**
PSP-100 x PSP-150	**3.216**	**0.005**	**Magnitude**
PSP-100 x PMP-100	1.287	0.217	Technique
PSP-100 x PMP-150	1.501	0.153	Technique × Magnitude
PMP-100 x PBA-150	**3.431**	**0.003**	**Technique × Magnitude**
PMP-100 x PSP-150	**4.503**	**< .001**	**Technique × Magnitude**
PMP-100 x PMP-150	**2.787**	**0.013**	**Magnitude**
PBA-150 x PSP-150	1.072	0.300	Technique
PBA-150 x PMP-150	0.643	0.529	Technique
PSP-150 x PMP-150	1.715	0.106	Technique

PBA-50, Periapical with bisecting angle technique; 50-μm misfits. PBA-100, Periapical with bisecting angle technique; 100-μm misfits. E, 50-μm misfits. PBA-150, Periapical with bisecting angle technique; 150-μm misfits. Periapical with standard paralleling technique. PSP-50, Periapical with standard paralleling technique; 50-μm misfits. PSP-100, Periapical with standard paralleling technique; 100-μm misfits. PSP-150, Periapical with standard paralleling technique; 150-μm misfits. PMP-50, Periapical with modified paralleling technique; 50-μm misfits. PMP-100, Periapical with modified paralleling technique; 100-μm misfits. PMP-150, Periapical with modified paralleling technique; 150-μm misfits.

Table 4. X-ray vertical angles used during radiographic exposures.

	Radiographic Technique		
	PBA	**PSP**	**PMP**
Minimum	25º	15º	12,5º
Maximum	70º	47.5º	45º
Median	42.5º	32.5º	30º

PBA, Periapical with bisecting angle technique. PSP, Periapical with standard paralleling technique.

PMP, Periapical with modified paralleling technique.

FIGURES

Figure 1 – Control group (no simulated misfit). Scanning electron microscopy image (original magnification ×100).

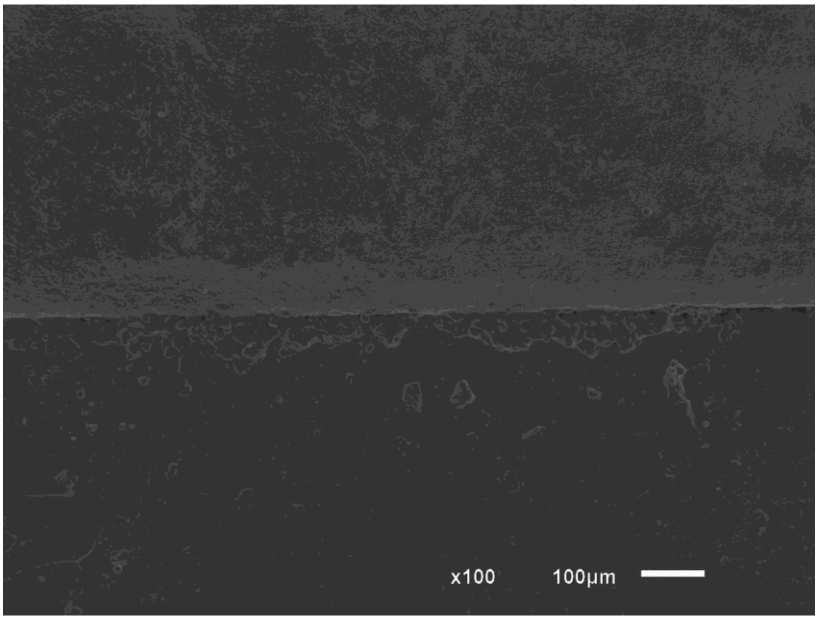


Figure 2 – Film holders used with the techniques. A, Periapical with bisecting angle technique. B, Periapical with standard paralleling technique. C, Periapical with modified paralleling technique.

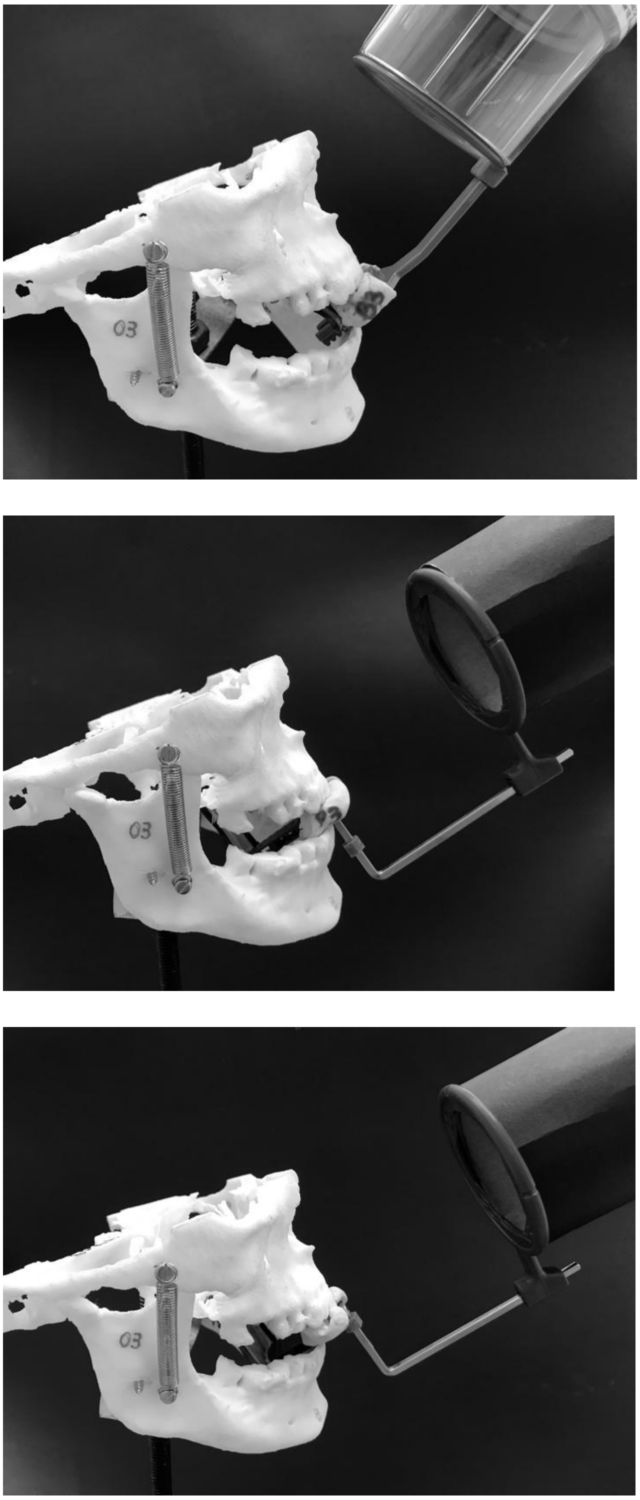
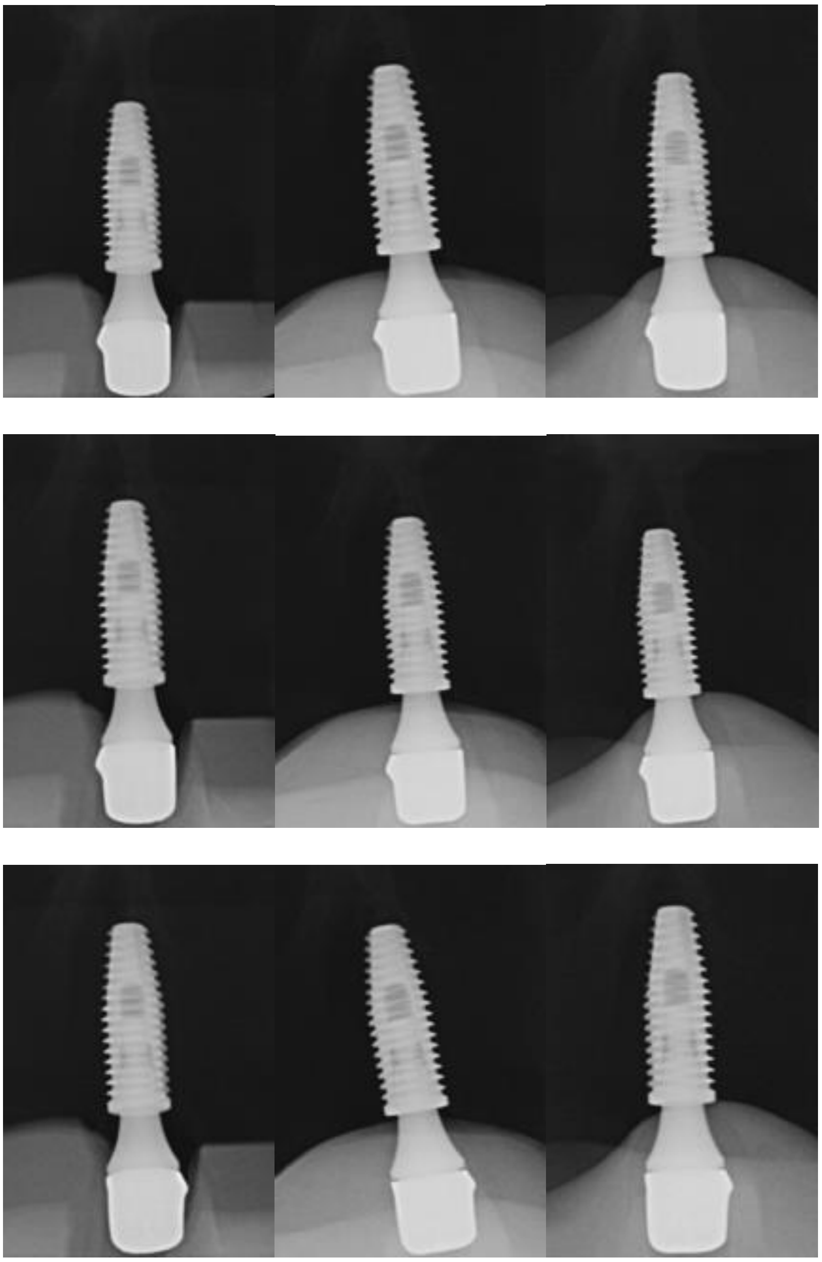


Figure 3 – Radiographs obtained for study. A, Control group. Periapical with bisecting angle technique. B, Control group. Periapical with standard paralleling technique. C, Control group. Periapical with modified paralleling technique. D, 50-μm misfit. Periapical with bisecting angle technique. E, 50-μm misfit. Periapical with standard paralleling technique. F, 50-μm misfit. Periapical with modified paralleling technique. G, 100-μm misfit. Periapical with bisecting angle technique. H, 100-μm misfit. Periapical with standard paralleling technique. I, 100-μm misfit. Periapical with modified paralleling technique. J, 150-μm misfit. Periapical with bisecting angle technique. K, 150-μm misfit. Periapical with standard paralleling technique. L, 150-μm misfit. Periapical with modified paralleling technique.



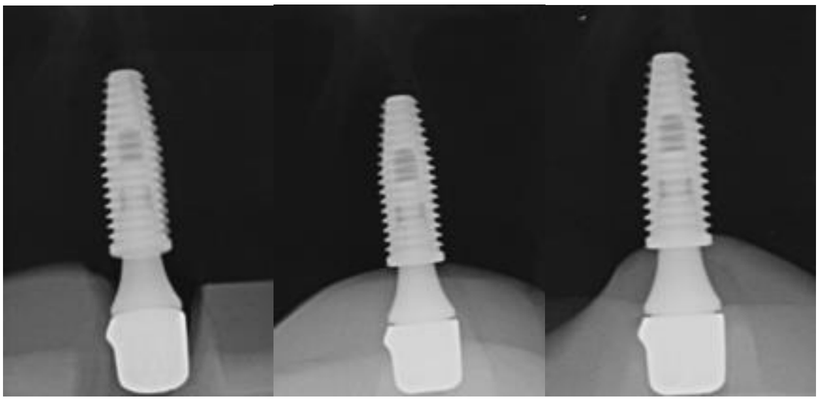
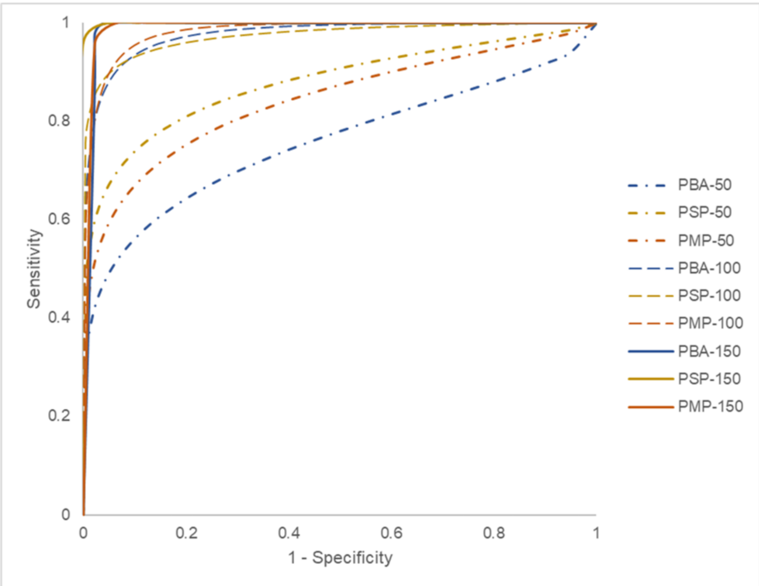


Figure 4 – Receiver operating characteristic curves generated. PBA-50, Periapical with bisecting angle technique; 50-µm misfits. PBA-100, Periapical with bisecting angle technique; 100-µm misfits. E, 50-µm misfits. PBA-150, Periapical with bisecting angle technique; 150-µm misfits. Periapical with standard paralleling technique. PSP-50, Periapical with standard paralleling technique; 50-µm misfits. PSP-100, Periapical with standard paralleling technique; 100-µm misfits. PSP-150, Periapical with standard paralleling technique; 150-µm misfits. PMP-50, Periapical with modified paralleling technique; 50-µm misfits. PMP-100, Periapical with modified paralleling technique; 100-µm misfits. PMP-150, Periapical with modified paralleling technique; 150-µm misfits.



ANEXO D – COMPROVANTE DE SUBMISSÃO

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