UNIVERSIDADE FEDERAL DE SERGIPE

PRÓ-REITORIA DE PÓS-GRADUAÇÃO E PESQUISA

PROGRAMA DE PÓS-GRADUAÇÃO EM ODONTOLOGIA

MESTRADO ACADÊMICO EM ODONTOLOGIA

AVALIAÇÃO RADIOGRÁFICA DA ACURÁCIA DIAGNÓSTICA DE LESÕES DE CÁRIES INTERPROXIMAIS EM DENTES POSTERIORES EM DIFERENTES "*DISPLAYS*" MÓVEIS

Aracaju
Fevereiro/ 2018

CRISTINNE ANDRADE MELO

AVALIAÇÃO RADIOGRÁFICA DA ACURÁCIA DIAGNÓSTICA DE LESÕES DE CÁRIES INTERPROXIMAIS EM DENTES POSTERIORES EM DIFERENTES "*DISPLAYS*" MÓVEIS

Dissertação apresentada ao Programa de Pós-Graduação em Odontologia da Universidade Federal de Sergipe como pré-requisito para a Defesa.

Orientador: Prof. Dr. Wilton Mitsunari Takeshita

Aracaju
2018

**FICHA CATALOGRÁFICA ELABORADA PELA BIBLIOTECA BISAU
UNIVERSIDADE FEDERAL DE SERGIPE**

M528a

Melo, Cristinne Andrade
Avaliação radiográfica da acurácia diagnóstica de lesões de cáries interproximais em dentes posteriores em diferentes "displays" móveis / Cristinne Andrade Melo; orientador Wilton Mitsunari Takeshita. – Aracaju, 2018.
48 f. : il.

Dissertação (mestrado em Odontologia) – Universidade Federal de Sergipe, 2018.

1. Odontologia. 2. Radiografia digital. 3. Cárie proximal. 4. Aplicativos móveis. I. Takeshita, Wilton Mitsunari, orient. II. Título.

CDU 616.314

"Tudo posso naquele que me fortalece"

Filipenses 4:13, Bíblia Sagrada

AGRADECIMENTOS

Obrigada primeiramente a Deus, pela força, proteção, paz e sabedoria em toda a minha vida, por guiar meus caminhos, colocar pessoas maravilhosas em minha vida e pelas conquistas!

Aos meus pais, Gleide e Geraldo, por acreditarem em mim e sempre me apoiarem em todas as minhas decisões. Por todo bem que me proporcionam! Vocês são as jóias mais preciosas que Deus me presenteou! Tudo de mais valioso que possuo na terra! Só Ele é capaz de mensurar como é grande o meu amor por vocês!

Aos meus familiares, amigos e meus sogros por se alegrarem comigo por mais esta vitória e por sempre torcer e acreditar em mim, amo todos vocês!

Ao meu noivo, Odilo, por sempre estar presente na minha vida, por me apoiar e me ajudar em todos os momentos. Muito obrigada pelos ensinamentos e pelas palavras de conforto. Te amo muito.

Ao meu orientador, Professor Dr. Wilton Mitsunari Takeshita, pela paciência, ensinamentos, ética, e confiança, diante dos meus questionamentos, dificuldades e limitações! Obrigada por tudo o que o senhor me proporcionou ao longo desses 2 anos, que além de um grande orientador, se tornou um grande amigo. Tudo o que conquistei no mestrado foi com sua ajuda. Muito obrigada e que Deus abençoe a você e sua família.

À professora, Dra. Maria de Fátima Batista de Melo, pelo carinho e risadas, por todo apoio no estágio docente e como professora voluntária, por toda ajuda na pesquisa e pelos conselhos que me deu durante toda a minha vida acadêmica e na pós-graduação.

À Prodonto, a coordenação de odontologia da Universidade Federal de Sergipe e aos professores do Mestrado Acadêmico em Odontologia, pelos ensinamentos e por fazerem parte deste sonho.

Ao departamento de odontologia e ao setor de radiologia odontológica, onde realizei minha pesquisa e que me ajudaram bastante. Também agradeço as funcionárias do setor de radiologia, Meire, Neide e Rita por todo carinho e ajuda.

Aos meus colegas de Mestrado, que sempre torceram por mim. Espero que todos alcancem seus sonhos.

As minhas bancas que durante cada apresentação me deram muitos conselhos e considerações.

A todos que intercedem por mim e, direta ou indiretamente, me ajudam a atravessar as lutas e desertos da vida e contribuíram para essa conquista! Que Deus possa recompensá-los.

RESUMO

Introdução: Os dispositivos móveis facilitam o acesso aos dados do paciente e podem ser usados para visualizar radiografias, eliminando a necessidade de extensos registros em papel e facilitando o acesso do cirurgião-dentista as radiografias. **Objetivo:** Avaliar a acurácia diagnóstica da radiografia digital interproximal com lesões de cárie visualizadas em *tablets* e *smartphones*. **Materiais e métodos:** Foram selecionadas 60 radiografias digitais interproximais, que possuíam imagens radiográficas de lesões cariosas em dentes posteriores, selecionadas a partir do arquivo projeto de extensão: PJ025-2016 "Serviço de atendimento a pacientes com necessidade de exames radiográficos especializados" dos pacientes do Departamento Odontológica do Hospital Universitário da Universidade Federal de Sergipe – UFS. Para a aquisição das imagens foi utilizado um sensor placa de fósforo de tamanho zero (área ativa 20 x 30 mm) do sistema digital iExpress® (Instrumentarium, Tuusula Finlândia), com resolução espacial 14,3 pl/mm, com posicionador para técnica radiográfica interproximal. As imagens radiográficas foram selecionadas por meio do consenso entre dois radiologistas com 15 e 30 anos de experiência, e posteriormente analisadas em dois *smartphones*: Iphone 6S (Apple, California, EUA) e Samsung Galaxy Gran 2 (DUOS) (Samsung, Seul, Coreia do Sul), e dois *tablets*: Ipad (Apple, California, EUA) e Samsung Galaxy Tab (Samsung, Seul, Coreia do Sul). **Resultados:** Os valores de Kappa (Kw) determinaram que o avaliador 1 apresentou concordância quase perfeita para todos os dispositivos, enquanto o avaliador 2 apresentou concordância substancial para todos os dispositivos. Os valores da área abaixo da curva ROC (Az) para o Smartphone IOS (0.944), Smartphone Android (0.916), Tablet IOS (0.949) e no Tablet Android (0.950) apresentaram acurácia semelhantes e não apresentaram diferenças estatisticamente significativas entre si ($p \leq 0,05$). **Conclusão:** Os displays estudados nesta pesquisa, possuem acurácia semelhante e podem ser utilizados para avaliar radiografias digitais sem alterar a capacidade de diagnóstico.

Descritores: Radiografia digital; Cárie proximal; Aplicativos móveis.

ABSTRACT

Background: Mobile devices facilitate access to patient data and can be used to visualize radiographs, eliminating the need for lengthy paper records and facilitating access by dental surgeons to radiographs. **Aim:** Evaluate the accuracy diagnostic of interproximal digital radiography with caries lesions seen on tablets and smartphones. **Materials and Methods:** Sixty interproximal digital radiographs were selected, which had radiographic images of carious lesions on posterior teeth, selected from extension project: PJ025-2016 "Service for patients with care specialized radiographic examinations" Department of Dentitstry of the Federal University of Sergipe – UFS. For the acquisition of the images, a zero-sized phosphor plate sensor (active area 20 x 30 mm) of the iExpress® digital system (Instrumentarium, Tuusula Finland) was used, with spatial resolution 14.3 pl / mm, with positioner for technique radiographic examination. The radiographic images were selected by consensus between two radiologists with 15 and 30 years of experience, and later analyzed in a LCD monitor Pavilion dm1 (HP, Palo Alto, Califórnia, EUA), two smartphones: Iphone 6S (Apple, California, USA) and Samsung Galaxy Gran 2 (DUOS) (Samsung, Seoul, Korea of the South), and two tablets: Ipad (Apple, California, USA) and Samsung Galaxy Tab (Samsung, Seoul, South Korea). **Results:** Kappa values (Kw) determined that the evaluator 1 presented almost perfect agreement for all the devices, whereas the evaluator 2 presented substantial agreement for all the devices. The values of the area below the ROC (Az) curve for LCD monitor (0.948), the IOS Smartphone (0.944), Android Smartphone (0.916), IOS Tablet (0.949) and Android Tablet (0.950) showed similar accuracy and did not present statistically significant differences ($\leq$ 0.05). **Conclusion:** The displays studied has a similar accuracy and can be used to evaluate digital radiographs without altering diagnostic capacity.

Keywords: Digital radiography; Dental caries; Mobile application.

SUMÁRIO

1. INTRODUÇÃO

A cárie dental é uma doença infecciosa que ameaça para a vitalidade pulpar e integridade dental acometendo grande parte da população. Possui uma etiologia multifatorial e é um dos principais problemas de saúde bucal em todo o mundo. O diagnóstico precoce é fundamental para o estabelecimento de medidas preventivas que busquem evitar a necessidade de tratamento invasivos. Ao realizar o diagnóstico precoce dos primeiros sinais de desmineralização do tecido duro podemos acelerar o processo de remineralização, diminuindo a chance de perda de tecido mineralizado, evitando necessidade de tratamentos restauradores ou reabilitadores, respectivamente, podendo ser realizado um tratamento não invasivo (ABDINIAN et al., 2015; DEPRÁ et al., 2015; NIKNESHAN et al., 2015; CHINN et al., 2013; TAKESHITA et al., 2013; YALÇINKAYA et al., 2012).

Atualmente, são utilizados vários métodos para diagnóstico das lesões cariosas, como transiluminação por fibra óptica, corantes de contraste e a combinação de exames clínicos e radiográficos. A técnica interproximal é mais sensível que a inspeção clínica para a detecção de lesões cariosas proximais e oclusais na dentina. Quando essas lesões cariosas são incipientes promovem uma incerteza em seu diagnóstico radiográfico, por não desenvolverem uma desmineralização suficiente para ser visualizada por meio de uma radiografia (ABDINIAN et al., 2015; VALIZADEH et al., 2015; VIEIRA et al., 2015; CHINN et al., 2013; YALÇINKAYA et al., 2012). Dentre os tipos de lesões cariosas, as interproximais são de difícil visualização clínica e geralmente são localizadas abaixo do ponto de contato ocupando o segundo lugar em termos de prevalência entre cáries dentárias. Essas cáries são geralmente diagnosticadas por inspeção visual associada à radiografia interproximal (NIKNESHAN et al., 2015; SHINTAKU et al., 2012; XAVIER et al., 2011; LI et al., 2008).

As inovações tecnológicas têm impactado significativamente a prática da odontologia e oferecem uma variedade de soluções inovadoras, alterando a prática odontológica tradicional na clínica de rotina (TADINADA et al., 2015). O sistema digital surgiu como um meio alternativo e tem muitas vantagens quando comparado à técnica convencional, por exemplo: permitir a troca de arquivos por redes locais e internet, facilitar a aquisição, armazenamento, transmissão e melhoramento da imagem através do uso de diferentes softwares, permite medições lineares e angulares na imagem, ajuste de brilho e contraste, ampliação da imagem, aplicação de cor e correção de superexposição ou subexposição, filtros para mostrar detalhes, redução da dose de radiação, tempo economizando imagem com melhor qualidade e menos distorção e requer menos espaço de armazenamento (ARAKI, et al., 2015; KALLIO-PULKKINEN et al., 2015; MIRI et al., 2015; VALIZADEH et al., 2015; VIEIRA et al., 2015; BELÉM et al., 2013; TAKESHITA et al., 2013; ULUSU et al., 2010).

Existem duas técnicas para obter a imagem digital, a técnica direta e semi-direta, onde são utilizados sensores específicos e a imagem formada vai diretamente para a tela de um computador (XAVIER et al., 2011). Os sensores digitais diretos e semi-diretos podem ser caracterizados em dois grandes grupos de detectores de sólidos: sistemas complementares de semicondutores de óxido metálico (CMOS) e sistemas de armazenamento de placas de fósforo (PSP), respectivamente. A resolução espacial é uma característica dos receptores digitais que diferencia os detalhes em uma imagem, geralmente expressa como pares de linhas por milímetro (lp / mm) (NIKNESHAN et al., 2015; VALIZADEH et al., 2015). Para a aquisição, processamento e armazenamento de dados de imagem, um dispositivo de raios-X, um receptor de imagem, computador e software são necessários (ARAKI et al., 2015; ULUSU et al., 2010).

Um dos principais fatores que afetam a qualidade da radiografia e interpretação digital é a exibição. Os cirurgiões dentistas raramente usam displays de exibição específicos e a precisão do diagnóstico pode ser comprometida pelo tipo de exibição, calibração em escala de cinza e nível de luz ambiente (ARAKI et al., 2015). A tela desempenha um papel importante na capacidade do detector ou sensor de radiação para formar e exibir uma imagem confiável. Nos últimos 10 anos, os ecrãs de cristais líquidos (LCDs) substituíram os monitores de tubo de raios catódicos (CRT) para exibir imagens digitais e, depois de essas telas LED terem sido amplamente utilizadas (VASCONCELOS et al., 2016; ILIĆ - STOJANOVIĆ et al., 2015).

Desde a introdução do Apple Ipad em abril de 2010, a prevalência de computadores *tablets* móveis aumentou rapidamente e já faz parte de grande parte do mercado de computadores. Com displays de alta resolução e interfaces de tela sensível ao toque, os *tablets* estão se tornando parte integrante de muitas indústrias, incluindo área da saúde. Para facilitar o acesso aos dados do paciente, eles podem ser usados para visualizar radiografias, acessar registros médicos digitais e eliminam a necessidade de extensos registros em papel (VASCONCELOS et al., 2016; KALLIO-PULKKINEN et al., 2015; LI et al., 2008). O interesse em usar *tablets* para este propósito aumentou devido à disponibilidade, portabilidade e facilidade de uso (HASHEM et al., 2015; TEWES et al., 2013; JOHN et al., 2012). Os *smartphones* são diferenciados dos *tablets* por tamanho, mas são amplamente utilizados por grande parte da população. A portabilidade desses dispositivos fornece ao radiologista uma extensão das funções de seu departamento, uma vez que permite a consulta e reduz a dependência de realizar um diagnóstico em local fixo (ARAKI et al., 2015; CAFFERY et al., 2015; EDIRISINGHE – CROSSETTE, 2012).

Uma série de fabricantes afirmaram que alguns dispositivos móveis são capazes de exibir diferentes tipos de imagens digitais em alta resolução (SHINTAKU et al., 2012). No entanto poucos trabalhos foram realizados comparando a acurácia no diagnóstico de cárie interproximais em diferentes tipos de tablets e smartphones. Adotando a hipótese nula de que haverá diferença na visualização de imagens nesses diferentes tipos de displays, o objetivo da pesquisa foi avaliar a acurácia diagnóstica da radiografia digital em lesões de cárie visualizadas por diferentes "*displays",* utilizando o consenso de especialistas experientes da área da radiologia odontológica, para destacar a importante relação entre o desempenho de exibição e interpretação de imagens digitais nestes dispositivos de visualização.

2. OBJETIVOS

2.1- Objetivo Geral:

Avaliar a acurácia diagnóstica da radiografia digital interproximal em dentes com lesões de cárie visualizados por diferentes “*displays”* móveis.

2.2- Objetivo Específico:

- Avaliar a acurácia radiográfica diagnóstica de lesões cariosas em *tablets.*
- Avaliar a acurácia radiográfica diagnóstica de lesões cariosas em *smartphones.*

3. METODOLOGIA

3.1 Tipo de Estudo

O trabalho realizado representa um estudo retrospectivo e comparativo para validação da acurácia diagnóstica das radiografias digitais visualizadas em *displays* para diagnóstico de lesões cariosas em dentes posteriores.

3.2 Aspectos Ético-legais

Este estudo foi submetido ao Comitê de Ética em Pesquisa com seres humanos do Hospital Universitário, da Universidade Federal de Sergipe, seguindo assim as normas da resolução 466/2012 do Conselho Nacional de Saúde (CNS), e foi iniciado após a aprovação sob protocolo de número 1.873.299 (ANEXO I). As radiografias interproximais digitais utilizadas na pesquisa foram selecionadas do arquivo do projeto de extensão: PJ025-2016 "Serviço de atendimento a pacientes com necessidade de exames radiográficos especializados" do departamento de Odontologia do Hospital Universitário da Universidade Federal de Sergipe.

3.3 Seleção da Amostra

Foram selecionadas 60 radiografias digitais interproximais, que possuíam imagens radiográficas com lesões cariosas em dentes posteriores, seguindo a metodologia aplicada na literatura e confirmada por meio de cálculo amostral de estudo piloto (DEPRÁ et al., 2015; ILIĆ - STOJANOVIĆ et al., 2015; TADINADA et al., 2015; TAKESHITA et al., 2013; EDIRISINGHE – CROSSETTE et al., 2012; XAVIER et al., 2011). O padrão-ouro foi determinado através do consenso entre dois avaliadores com 15 e 30 anos de experiência. As 14 radiografias que tiveram diagnóstico diferente foram excluídas da pesquisa e as 46 que foram coincidentes permaneceram na pesquisa como grupo controle. Ao total foram analisadas 92 unidades dentárias, dispostos de forma randomizada e diferente para cada dispositivo (TERRY et al., 2016; KALLIO-PULKKINEN et al., 2016; KALLIO-PULKKINEN et al., 2015; KALLIO-PULKKINEN et al., 2014).

3.3.1 Cálculo da amostra:

O tamanho mínimo da amostra foi calculado com a equação: N = Z * Z (P (1-P)) / (D * D). N = tamanho mínimo da amostra, P = proporção esperada, D = intervalo médio do intervalo de confiança e Z = 1,96 (para α = 0,05 e IC 95%). Desta forma, para uma sensibilidade de 80% do teste com 95% de intervalo de confiança e precisão em 0,05. Então, 3.8416 * (0.20 (1-0.20) / (0.05) 2 = 24.58. Portanto, são necessárias vinte e quatro radiografias (FLEISS et al., 2003).

Foram adotados os seguintes critérios de inclusão:

- Presença de cárie interproximal;
- Imagem radiográfica sem distorção;
- Ausência de sobreposição das superfícies proximais dos dentes vizinhos;
- Imagem radiográfica sem erro de angulação;
- Tela do *display* em perfeito estado.

E como critérios de exclusão:

- Imagem radiográfica com distorção;
- Imagem com erros de angulação do filme radiográfico;
- Imagem radiográfica com a sobreposição dos dentes vizinhos;
- *Displays* com trincas, rachaduras, arranhões na tela.

3.4 Procedimentos para coleta de dados

As radiografias coletadas possuem estruturas a serem avaliadas, compatíveis com lesão de cárie em dentes posteriores. Todas as imagens escolhidas estavam dentro das normas de qualidade, rotina e exposição e as que possuíam erros de posição, com movimento que prejudiquem a imagem não eram permitidos ou artefatos na imagem foram excluídas. Foi utilizado como “padrão ouro” o consenso entre dois profissionais com 15 e 30 anos de experiência com relação a presença ou não da lesão de cárie (TERRY et al., 2016; KALLIO-PULKKINEN et al., 2016; KALLIO-PULKKINEN et al., 2015; KALLIO-PULKKINEN et al., 2014; SHINTAKU et al., 2012).

3.4.1 Exames Radiográficos

As radiografias interproximais foram obtidas por um aparelho de raios X Odontológico 70X (Dabi Atlante, São Paulo, Brasil), com calibração mecânica averiguada anteriormente e com os fatores técnicos de exposição fixos de 70 kVp, 8 mA. Para a aquisição das imagens foi utilizado um sensor placa de fósforo de tamanho 0, (área ativa 20 x 30 mm) do sistema digital iExpress® (Instrumentarium, Tuusula Finlândia), escaneadas imediatamente após a aquisição, software Cliniview

(Instrumentarium, Tuusula Finlândia) com resolução espacial 14,3 pl/mm, com posicionador para técnica radiográfica interproximal. O tamanho da matriz da imagem foi 1932 × 1496 pixels (0,02 × 0,02 tamanho do pixel mm no detector) em radiografias (KALLIO-PULKKINEN et al., 2016; KALLIO-PULKKINEN et al., 2015; KALLIO-PULKKINEN et al., 2014). Após as incidências radiográficas, as imagens foram armazenadas no formato TIFF utilizando um computador com processador Intel Core I7 com 8 gigahertz de memória RAM, hard disk de 500 gigabites, sistema operacional Windows 10 64 bits, e posteriormente foram visualizadas nos diferentes "*displays*".

3.4.2 Análise das imagens radiográficas

As imagens foram dispostas nos displays analisadas por dois radiologistas com mais de 15 e 30 anos de experiência (KALLIO-PULKKINEN et al., 2016; KALLIO-PULKKINEN et al., 2015; KALLIO-PULKKINEN et al., 2014). Para verificar a concordância intra e inter-examinadores foi utilizado o teste Kappa. Antes das sessões de observação, instruções verbais e escritas foram dadas aos observadores como forma de calibração entre os mesmos. O ajuste de brilho, contraste e zoom foram padronizados pela pesquisadora. Os ambientes para avaliação foram os mesmos para ambos os avaliadores com a mesma condição de luminosidade. Para análise foram utilizados dois *smartphones*: Iphone 6S (Apple, California, EUA) e Samsung Galaxy Gran 2 (DUOS) (Samsung, Seul, Coreia do Sul), e dois *tablets*: Ipad (Apple, California, EUA) e Samsung Galaxy Tab (Samsung, Seul, Coreia do Sul) (Tabela 1).

Tabela 1: Especificações dos *displays.*

	Pavilion dm 1 (Grupo Controle)	**Iphone 6s**	**Gran Duos 2**	**Ipad**	**Samsung Tab**
Polegadas	15.6"	4.7"	5.25"	9.7"	7"
Resolução	1920x1080 pixels	1334x750 pixels	1280x720 pixels	2048x1536 pixels	1024x600 pixels
PPI	137.7	326	280	264	170
Tipo	LCD	LCD	TFT LCD	LED	TFT LCD

Fonte: Especificações dos fabricantes: Apple, Samsung e HP.

O grupo controle foi selecionado por meio da visualização das 60 radiografias no monitor de tela LCD Pavilion dm1 (HP, Palo Alto, Califórnia, EUA) (ARAKI et al., 2015). Para diminuir a chance de viés, foram selecionadas duas unidades dentárias de cada radiografia, totalizando 120 unidades dentárias para serem analisadas em todos os 5 dispositivos. Para diagnosticar a presença ou ausência de cárie dentária, foi utilizada uma escala de classificação na qual se divide em cinco níveis (ABDINIAN et al., 2015; DEPRÁ et al., 2015; TAKESHITA et al., 2014; TAKESHITA et al., 2013; XAVIER et al., 2011; WENZEL et al., 2002):

1. Certeza de presença de lesão cariosa;
2. Incerteza da presença de lesão cariosa;
3. Diagnóstico duvidoso;
4. Incerteza da ausência de lesão cariosa;
5. Certeza da ausência de lesão cariosa.

As imagens radiográficas foram dispostas em ordem pelo pesquisador e fichas de avaliação confeccionadas personalizadas para cada *display* avaliado (APÊNDICE A), onde continha a legenda da escala e a unidade dentária a ser avaliada em ordem coincidente com a exibida no display. Toda a etapa de visualização realizada pelos observadores foi supervisionada pelo pesquisador a fim de evitar erros e equívocos. Após a avaliação, os resultados dos observadores foram comparados, as imagens que tiveram diagnóstico diferente, foram 14 radiografias excluídas da pesquisa e as 46 que foram coincidentes permaneceram na pesquisa como grupo controle. Ao total seriam analisadas 92 unidades dentárias, dispostos de forma randomizada e diferente para cada dispositivo. Para o observador não identificar qual dispositivo estava sendo analisados, foram confeccionadas máscaras com cartolina preta (Figura 1).

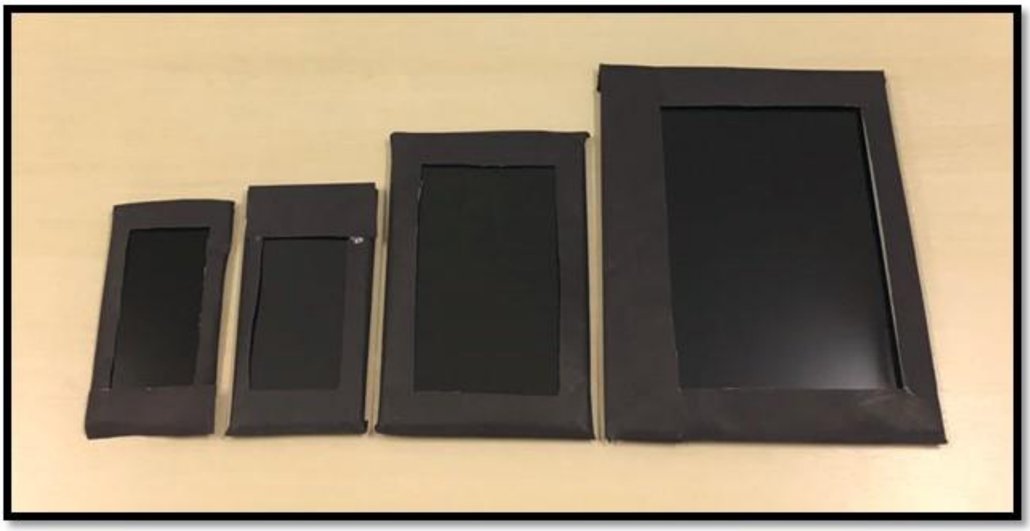


Figura 1: *Displays* com as máscaras de cartolina preta.

Os observadores avaliavam o mesmo dispositivo em um dia, sobre as mesmas condições de luminosidade e após 15 dias, avaliavam outro dispositivo, para minimizar o efeito da memória. Finalizando todas as avaliações em 8 semanas, as imagens foram avaliadas novamente após 15 dias. Os dados obtidos com os resultados dos observadores foram tabulados no software Microsoft Excel versão 2010 para Windows 64 bits (Microsoft Corporation, Redmond, WA, USA) e realizado análise estatística.

3.5 Análise Estatística

Para determinar a precisão, o teste Kappa foi utilizado para verificar a confiabilidade intra-examinador e inter-examinador (LANDIS - KOCH, 1977). Landis e Koch sugerem a seguinte interpretação:

Tabela 2 – Valores de Kappa e interpretação.

Valores de Kappa	Poder de concordância
<0	Nenhum
0-0.19	Pobre
0.20-0.39	Regular
0.40-0.59	Moderado
0.60-0.79	Substancial
0.80-1.00	Quase perfeito

Para determinar a precisão, foram construídas as curvas características operacionais do receptor (ROC) para cada alteração estudada para os quatro dispositivos, considerando as cinco pontuações utilizadas no diagnóstico. As áreas sob as curvas (precisão) foram comparadas com o teste exato Binomial. Todos os testes foram realizados com SPSS®, versão 22.0 (IBM Corporation, Armonk, NY, EUA) para Microsoft Windows com um nível de significância de 95% ($P \leq 0,05$).

4. RESULTADO

Evaluation of diagnostic accuracy of radiographs showing interproximal dental caries viewed on different "displays"

Cristinne A. Melo, DDS[1]

Maria de Fátima B. de Melo, Ph.D., M.SC, DDS[2]

Wilton M. Takeshita, Ph.D., M.SC, DDS[2]

[1]Graduate Student, Bachelor of Science in Dentistry, Federal University of Sergipe, Brazil.

[2]Professor, Department of Odontology, Federal University of Sergipe, Brazil.

ABSTRACT

Objective: To evaluate the diagnostic accuracy of interproximal digital radiography with caries lesions seen on tablets and smartphones. This is the first study to evaluate interproximal caries by using smartphones. **Materials and Methods:** Forty-six interproximal digital radiographs were selected, which had radiographic images of carious lesions on posterior teeth. For image acquisition, a zero-sized phosphor plate sensor (active area 20 x 30 mm) of the iExpress® digital system (Instrumentarium, Tuusula Finland), with a spatial resolution of 14.3 pl/mm, was used with a positioner for radiographic technique examination. The radiographic images were selected by consensus between two radiologists with 15 and 30 years of experience and later analyzed on a Pavilion dm1 LCD monitor (HP, Palo Alto, California, USA), two smartphones: iPhone 6S (Apple, California, USA) and Samsung Galaxy Gran 2 (DUOS) (Samsung, Seoul, Korea of the South), and two tablets: iPad (Apple, California, USA) and Samsung Galaxy Tab (Samsung, Seoul, South Korea). To determine precision, Kappa test was used to verify intra-examiner and inter-examiner reliability. To determine accuracy, receiver operating characteristic (ROC) curves for each alteration studied were constructed for the four devices, considering the five scores used in the diagnosis. The areas under the curves were compared with the Binomial exact test. **Results:** Kappa coefficients (κ) determined that the observations of evaluator 1 were in almost perfect agreement for all the devices, whereas those of evaluator 2

were in substantial agreement for all the devices. The values of the area below the ROC (Az) curve for the LCD monitor (0.948), the iOS Smartphone (0.944), Android Smartphone (0.916), iOS Tablet (0.949), and Android Tablet (0.950) showed similar accuracy and did not present statistically significant differences ($P \leq 0.05$). **Conclusion:** The displays used in this study have similar accuracy and can be used to evaluate digital radiographs without altering diagnostic capacity. The screen size, resolution, PPI, and screen type did not change the accuracy results regarding the diagnosis of caries.
Keywords: Digital radiography; Dental caries; Mobile application.

Introduction

Dental caries are an infectious disease that threatens pulpal vitality and dental integrity, affecting much of the population. They have a multifactorial etiology and are one of the most prevalent oral health problems in the world. Early diagnosis is essential for the establishment of preventive measures that seek to avoid the need for invasive treatment. When we diagnose hard-tissue demineralization early, we can accelerate the remineralization process, reducing the chances of loss of mineralized tissue, avoiding the need for restorative or rehabilitative treatments, and provide the patient with a non-invasive treatment.[1-6] This is the first study to evaluate the use of smartphones in the diagnosis of interproximal caries.

Several methods are currently used to diagnose carious lesions, such as fiber-optic transillumination, contrast dyes, and the combination of clinical and radiographic exams. The interproximal technique is more sensitive than clinical inspection for the detection of proximal and occlusal carious lesions in the dentin. When these carious lesions are incipient, their radiographic diagnosis may be uncertain, because they do not develop sufficient demineralization to be visualized by means of an x-ray.[1,4,6-8] Among the types of carious lesions, interproximal ones are the second most prevalent, are difficult to visualize clinically and are usually located below the point of contact. These cavities are usually diagnosed by visual inspection associated with interproximal radiography.[3,9-11]

Technological innovations have significantly impacted the practice of dentistry and offer a variety of innovative solutions by changing the traditional dental practice in the routine clinic.[12] The digital system has emerged as an alternative medium and has many advantages over the conventional technique, including allowing the exchange of files via local networks and the internet; ease of acquisition, storage, transmission, and improvement of the image through the use of different software; allowing linear and angular measurements on the image, adjustment of brightness and contrast, enlargement of the image, application of color, correction of overexposure or underexposure, and the use of filters to show details; reduced radiation dose; time saving; a better quality image with less distortion; and less storage space required.[5,7, 8, 13-17]

There are two types of techniques for obtaining digital images, direct and semi-direct techniques, where specific sensors are used, and the formed image goes directly to the screen of a computer.[10] Direct and semi-direct digital sensors can be characterized into two large groups of solid detectors: complementary metal oxide semiconductor systems and phosphor plate storage systems (PSP). Spatial resolution is a characteristic of digital receivers that differentiates details in an image, usually expressed as pairs of lines per millimeter (lp/mm).[3,7] For the acquisition, processing and storage of image data, an X-ray device, an image receiver, a computer, and software are required.[13,17]

One of the key factors that affect the quality of digital radiography and interpretation is the display. Dental surgeons rarely use specific displays, and diagnostic accuracy can be compromised by display type, grayscale calibration, and the ambient light level.[13] The screen plays an important role in the ability of the detector or radiation sensor to form and display a reliable image. In the last 10 years, liquid crystal displays (LCDs) have replaced cathode ray tube monitors to display digital images, and after these, LED screens have been widely used.[18,19]

Since the introduction of the Apple iPad in April 2010, the prevalence of mobile tablet computers has increased rapidly, and they already make up a large part of the computer market. With high-resolution displays and touch-screen interfaces, tablets are becoming an integral part of many industries, including healthcare. In order to provide easy access to the patient's educational material, they can be used to visualize radiographs, access digital medical records, and eliminate the need for extensive paper records.[11,14,18] The interest in using tablets for this purpose has increased due to availability, portability, and ease of use.[20-22] Smartphones are differentiated from tablets by their size, but are widely used by much of the population. The portability of these devices provides the radiologist with an extension of the functions of his department, since it allows consultation and reduces the dependence on conducting a diagnosis at a fixed location.[13,23,24]

A number of manufacturers have stated that some mobile devices are capable of displaying different types of digital images at high resolution.[9] However, few studies have been carried out comparing the diagnostic accuracy of interproximal caries on different tablets. This is the first study of interproximal caries evaluated by using smartphones. Therefore, the objective of this study was to evaluate the diagnostic accuracy of digital radiography in caries lesions visualized by different mobile displays, using the consensus of experts in the area of dental radiology, to highlight the important relationship between the performance of the display and interpretation of images on these display devices.

Materials and Methods

Type of Study

The present work represents a retrospective and comparative study to validate the diagnostic accuracy of digital radiographs visualized in displays for diagnosis of carious lesions in posterior teeth.

Ethical and Legal Aspects

This study was submitted to the Human Research Ethics Committee of the University Hospital of the Federal University of Sergipe, following the norms of Resolution 466/2012 of the National Health Council (CNS) and was initiated after approval under protocol 1.873.299. The digital interproximal radiographs used in the research were selected from the file of the extension project: PJ025-2016 "Service of care for patients with need for specialized radiographic examinations" of the Department of Dentistry of the University Hospital of the Federal University of Sergipe.

Sample Calculation

In the present study, we evaluated 60 interproximal digital radiographs, which had radiographic images of carious lesions in posterior teeth, following the methodology applied in the literature and confirmed by calculation of the sample: N = Z * Z (P (1-P)) / (D * D). N = minimum sample size, P = expected proportion, D = mean confidence interval, and Z = 1.96 (for $\alpha = 0.05$ and 95% CI). Therefore, for a test with 80% sensitivity, a 95% confidence interval, and an accuracy of 0.05, the sample size required is given by the formula 3.8416 * (0.20 (1-0.20) / (0.05) 2 = 24.58. Therefore, twenty-four radiographs are required.[2,5,10,12,19,24,25]

The "gold standard" for this study was established by a consensus of two professionals with 15 and 30 years of experience in validation. After the evaluation, the observers' results were compared, the 14 radiographs that had been diagnosed differently were excluded from the survey, and the 46 that coincided remained in the study as a control group. A total of 92 dental units were randomly and differently arranged for each device. The following inclusion criteria were used to select the radiographic images and displays: presence of interproximal caries, radiographic image without distortion, absence of overlapping of the proximal surfaces of neighboring teeth and display screen in perfect condition.

Procedures for Data Collection

Radiographs of structures compatible with caries lesions in posterior teeth were collected for evaluation. All the images chosen were within the norms of quality, routine, and exposure, and those with position errors, movement that distorted the image, or artifacts in the image were excluded. The "gold standard" for this study was established by a consensus of two professionals with 15 and 30 years of experience in validation.[9,14,26,27,28]

The interproximal radiographs were obtained in the radiology laboratory of the dentistry department of the university hospital of the Federal University of Sergipe–Brazil, by a 70X dental X-ray machine (Dabi Atlante, São Paulo, Brazil), with mechanical calibration previously verified and with fixed technical exposure factors of 70 kVp, 8 mA. For image acquisition, a 0-mm phosphor plate sensor (active area 20 x 30 mm) of the iExpress® digital system (Instrumentarium, Tuusula Finland) was used. Images were scanned immediately after acquisition and analyzed using CLIN iView software (Instrumentarium, Tuusula Finland) with a spatial resolution of 14.3 pl/mm and a positioner for the interproximal radiographic technique. The image matrix size was 1932 × 1496 pixels (0.02 × 0.02 mm pixel size in the detector) on interproximal radiographs.[14,27,28] After the radiographic were acquired, the images were stored in TIFF format using a computer with an Intel Core i7 processor with 8 GHz of RAM, a 500 Gb hard disk, and a Windows 10 64-bit operating system and then viewed on the different displays.

Analysis of Radiographic Images

The images were arranged on the displays and analyzed by two radiologists with more than 15 and 30 years of experience.[14,27,28] The Kappa test was used to verify intra- and inter-examiner agreement. Before the observation sessions, verbal and written instructions were given to the observers as a form of calibration between them. The adjustment of brightness, contrast, and zoom was standardized by the principal investigator. The two radiologists conducted their evaluations in identical environments with the same luminosity. The control group consisted of images viewed on the LCD monitor (HP, Palo Alto, California, EUA). For the analysis, two smartphones, an iPhone 6S (Apple, California, USA) and a Samsung Galaxy Gran 2 (DUOS) (Samsung, Seoul, South Korea), and two tablets, an iPad (Apple, California, USA) and a Samsung Galaxy Tab (Samsung, Seoul, South Korea), were used (Table 1).

To reduce the chances of bias, two dental units were selected from each radiograph, totaling 96 teeth to be analyzed on all five devices. In order to diagnose the presence or absence of dental caries, a classification scale divided into five levels was used:[1,2,5,10,29,30]

1. definitely a finding.
2. probably a finding.
3. unable to evaluate.
4. probably not a finding.
5. definitely not a finding.

The radiographic images were arranged in order by the researcher, and evaluation sheets, which contained a scale bar and the dental unit to be evaluated in the order coincident with the one on the display, were prepared for each display to be evaluated. The entire viewing stage performed by observers was supervised by the principal investigator to avoid errors and misunderstandings. After the evaluation, the observers' results were compared, the 14 radiographs that were diagnosed differently were excluded from the survey, and the 46 that were coincident remained in the research as a control group. A total of 92 dental units, randomly and differently arranged for each device, were analyzed. Blinding of the observer to the device under analysis was achieved with black cardboard masks (Figure 1).

The observers evaluated one device in a single day, and under the same lighting conditions after 15 days, they evaluated another device to minimize the effect of memory. After 8 weeks, when all the evaluations had been completed, the images were evaluated again after 15 days. The data obtained from the observers were tabulated in the software Microsoft Excel version 2010 for 64-bit Windows (Microsoft Corporation, Redmond, WA, USA), and statistical analysis was performed.

Data Analysis

To determine precision, a Kappa test was used to verify intra- and inter-examiner reliability.[31] We used the interpretation of Landis and Koch. To determine accuracy, receiver operating characteristic (ROC) curves for each alteration studied were constructed for the four devices, considering the five scores used in the diagnosis. The areas under the curves (accuracies) were compared with the binomial exact test. All the tests were performed with SPSS®, version 22.0 (IBM Corporation, Armonk, NY, USA) for Microsoft Windows at a confidence interval of 95% ($P \leq 0.05$).

Results

Regarding the Kappa (κ) test, Table 2 presents the intra- and inter-examiner evaluations for the different devices. The intra-examiner values of evaluator 1 presented almost perfect agreement for all the devices. Regarding evaluator 2, they presented substantial agreement for all the devices.

The inter-examiner values were considered in substantial agreement for the iOS smartphone, Android smartphone, and iOS tablet. The control and the Android tablet showed almost perfect agreement.

According to Table 3 and Figure 2, all the devices showed similar accuracy and can be used for diagnosis. In addition, there was no statistically significant difference between them (Table 4).

Table 5 shows the display type, area under the curve, and 95% confidence interval for all observers. Comparisons between the areas under the ROC curves of the different devices using the exact binomial test ($P \leq 0.05$) for all observers are shown in Table 6.

Discussion

Despite the variety of diagnostic methods for caries disease, 25% to 45% of cases are not detected, and this is considered as one of the greatest diagnostic challenges in dentistry.[1,7] The ability to detect incipient caries is extremely important because, if diagnosed at this stage, their progression can be prevented, reducing the chances of tooth loss and minimizing or even eliminating the need for future restorative treatments.[5,6] Nevertheless, although caries disease is common and easy to treat, there is still controversy and barriers to diagnosis. Therefore, in our research, we evaluated the diagnostic accuracy of digital radiography for interproximal carious lesions by using radiographs from the radiology department of the Federal University of Sergipe in order to verify the effectiveness of the use of other mobile displays in the perception of interproximal carious lesions, we compared the use of smartphones and tablets for diagnostic viewing by highly trained radiographers.

Shintaku et al. (2012)[9], Kallio-Pulkkinen et al. (2014)[28], Hashem et al. (2015)[20], Araki et al. (2015)[13], and Kallio-Pulkkinen et al. (2016)[27] compared the detection of carious lesions on different displays, using the iPad and LCD or DICOM monitors. At present, there is no study comparing the performance of other tablets and smartphones for evaluation of carious lesions on digital interproximal radiographs. Our research is the first to adopt the methodology of comparing the diagnostic accuracy of different smartphones in the detection of carious lesions on digital interproximal radiographs.

Radiography is used to detect caries in the clinical setting and the development of digital radiography has provided dentistry with an effective method of diagnosing the disease.[9] Studies have shown that these systems have a superior diagnostic accuracy to that of conventional radiography.[1,3] A study reported by Yalçınkaya et al. (2012)[6] assessed the depth of carious lesions seen in conventional periapical radiography and digital periapical radiography by four different systems, using histological evaluation as the gold standard, and concluded that the digital radiographic method is acceptable for detection of carious lesions and superior to the conventional method. According to Takeshita et al. (2013)[5], the digital system obtains images of X-rays and provides more dynamic images, which facilitates the diagnosis and interpretation of proximal changes, in addition to providing the dental surgeon with a range of filters that aid in the detection of caries, along with image editing and the capacity to zoom in, which allows an increase in the size of the radiographic image.[7,15] For this reason, we decided to conduct a study evaluating the diagnostic accuracy of digital radiography in visualizing interproximal carious lesions on different mobile displays. We raise the hypothesis that portable devices can transmit a radiographic image of the same quality as an LCD or LED monitor.

The 46 digital interproximal radiographs used in the research were selected by a consensus of two professionals with 15 and 30 years of experience. The collected radiographs showed structures compatible with caries lesions in posterior teeth for evaluation. Kallio-Pulkkinen et al. (2014)[28], Kallio-Pulkkinen et al. (2015)[14], Kallio-Pulkkinen et al. (2016)[27], and Terry et al. (2016)[26] also used consensus among experienced professionals to establish a gold standard for their studies. To evaluate the presence or absence of carious lesions in our study, we used a 5-point scale. The same scale was used by Shintaku et al. (2012)[9], Abdinian et al. (2015)[1], Kallio-Pulkkinen et al. (2014)[28], Kallio-Pulkkinen et al. (2015)[14], Kallio-Pulkkinen et al. (2016)[27], and Xavier et al. (2011)[10] in their studies.

Shintaku et al. (2012)[9] evaluated 27 digital bitewing radiographs presented to four dentists in two sessions. They compared the detection of interproximal caries on digital intraoral images presented on a 24-inch LCDs monitor and the iPad 2. Pakkala et al. (2012)[32] compared the accuracy of caries diagnosis on different displays and with varying room illumination using an off-the-shelf color display, of the type which might be found at a dental practice, a DICOM-calibrated color (LCD) clinical viewing station, and a DICOM-calibrated grayscale LCD. There were no significant differences in accuracy between the different display types. Araki et al. (2015)[13] compared the caries diagnostic ability between DICOM LCD monitor, LCD monitor, and an iPad Air tablet and observed that the DICOM monitor and LCD monitor have similar capabilities. In most studies found in the literature, authors promote LCD monitors as an effective method for viewing radiographs and often use them as a reference for comparison with other types of displays. The evaluation of LCD monitors has already been reported in the literature; in our research we used radiographic evaluation with an LCD monitor as a reference for comparison with the other displays.

According to John et al. (2012)[22], tablets have a good graphic display resolution and a touch screen, offering an advantage in comparison with existing mobile devices such as smartphones and laptops for viewing radiological images. In their research, they compared the first-generation iPad and 6 Mbp diagnostic display monitors in order to assess the potential of the iPad for emergency radiology teleconsultation, concluding that tablets, with their excellent portability and large screens, may have potential as devices for review and analysis of mobile radiological images. Despite the proven diagnostic efficacy of the tablet, no authors have studied the diagnostic accuracy of other branded tablet devices. Our study compared two tablets from different brands, in addition to testing the effectiveness of smartphones, finding no significant difference between the displays tested.

We performed a Kappa (κ) test to evaluate intra-examiner and inter-examiner reliability for the different devices. The intra-examiner values of evaluator 1 presented almost perfect agreement for all the devices. Regarding evaluator 2, they presented substantial agreement for all the devices, and the inter-examiner values were considered in substantial agreement for the iOS smartphone, Android smartphone, and iOS tablet. The control and the Android tablet showed almost perfect agreement. The intra-observer reliability observed in the study by Kallio-Pulkkinen et al. (2015)[14] was moderate at the cementoenamel junction and almost perfect at the top. The inter-observer reliability between the readers was fair in upper and substantial in lower enamel caries and was moderate in upper and substantial in lower dentinal caries. The difference in results may have been because, in the study by Kallio-Pulkkinen et al. (2015)[14], the author performed the evaluation by dividing the teeth into points, and in our research, we analyzed the crown in its entirety.

In the research of Shintaku et al. (2012)[9], Az values for the iPad 2 and LCD monitor were 0.87 and 0.86, respectively. For the tablet, the mean values of sensitivity, specificity, and accuracy were 0.75, 0.86, and 0.83, respectively. For the LCD monitor, these values were 0.77, 0.82, and 0.80, respectively. For the evaluation of interproximal caries, the iPad 2 can effectively show images comparable with the evaluated LCD monitor. Caffery et al. (2015)[23], reported high sensitivity (84%–98%), specificity (74%–100%), and accuracy rates (98%–100%) for radiological diagnosis. There was no statistically significant difference in accuracy between a tablet computer and a control display calibrated for digital imaging and communication in medicine. Araki et al (2015)[13] found areas under the ROC curve (AUC) for the DICOM monitor, PC monitor, and tablet PC of 0.68147, 0.67002, and 0.60189, respectively. There were no significant differences among the monitors for the evaluation of dentin caries.

In the ROC curve, our study showed that all devices have similar accuracy and suitability for diagnosis, and there were no statistically significant differences between them. According to Tables 3, 4, and 5 and Figures 2 and 3, all the devices showed similar accuracy and can be used for diagnosis, with no statistically significant differences between them. Our results agree with studies carried out by Kallio-Pulkkinen et al. (2014)[28], Shintaku et al. (2012)[9], Haak et al. (2003)[33], John et al. (2012)[22], and Tadinada et al. (2015)[12]. Thus, we can conclude that our study results are similar to those of previously published research. Further studies are required to evaluate the diagnostic accuracy of tablets and smartphones in dentistry, as well as in the diagnoses of other coronary alterations, root and periapical changes. In addition, their use with different modalities of radiographic images and the use of other brands and models available in the market should be evaluated.

Conclusion

The displays used in this study have similar accuracy and can be used to evaluate digital radiographs without altering diagnostic capacity. The screen size, resolution, PPI, and screen type did not change the accuracy results regarding the diagnosis of caries.

Reference

1- Abdinian M, Razavi SM, Faghihian R, Samety AA, Faghihian E. Accuracy of digital bitewing radiography versus different views of digital panoramic radiography for detection of proximal caries. J Dent (Tehran). 2015;12(4):290-297.

2- Deprá LC, Vessoni Iwaki LC, Chicarelli M, Takeshita WM. Influence of image filters and variation in horizontal angle of incidence of x-ray beam in digital interproximal radiographs for diagnosis of secondary caries in esthetic restorations. J Contemp Dent Pract. 2015;16(10):805-812.

3- Nikneshan S, Abbas FM, Sabbagh S. Detection of proximal caries using digital radiographic systems with different resolutions. Indian J Dent Res. 2015;26(1):5-10. doi: 10.4103/0970-9290.156787.

4- Chinn CH, Levine J, Matos S, Findley S, Edelstein BL. An interprofessional collaborative approach in the development of a caries risk assessment mobile tablet application: My Smile Buddy. J Health Care Poor Underserved. 2013 Aug;24(3):1010-20.

5- Takeshita WM, Iwaki LC, Da Silva MC, Iwaki-Filho L, Queiroz AD, Geron LB. Comparison of the diagnostic accuracy of direct digital radiography system, filtered images, and subtraction radiography. Contemp Clin Dent. 2013;4(3):338-342. doi: 10.4103/0976-237X.118391.

6- Yalçinkaya SE, Künzel A, Becker J. In vitro comparison of intraoral films and four image plate systems in radiographic caries diagnosis. Müsbed. 2012;2(4):175-180.

7- Valizadeh S, Goodini M, Ehsani S, Mohseni H, Azimi F, Bakhshandeh H. Designing of a computer software for detection of approximal caries in posterior teeth. Iran J Radiol. 2015; 12(4): e16242. doi: 10.5812/iranjradiol.12(2)2015.16242.

8- Vieira MS, Nogueira CPR, Silva MAS, Bauer JRO, Maia-Filho EM. In vitro evaluation of proximal carious lesions using digital radiographic systems. Scientific World Journal. 2015;2015:631508. doi: 10.1155/2015/631508.

9- Shintaku WH, Scarbecz M, Venturin JS. Evaluation of interproximal caries using the IPad 2 and a liquid crystal display monitor. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;113(5):40-44. doi: 10.1016/j.oooo.2011.11.008.

10- Xavier CRG, Araujo-Pires AC, Poleti ML, Rubira-Bullen IRF, Ferreira-Junior O, Capelozza ALA. Evaluation of proximal caries in images resulting from different modes of radiographic digitalization. Dentomaxillofac Radiol. 2011;40(6):338-343. doi: 10.1259/dmfr/67185962.

11- Li G, Berkhout WE, Sanderink GC, Martins M, van der Stelt PF. Detection of in vitro proximal caries in storage phosphor plate radiographs scanned with different resolutions. Dentomaxillofac Radiol. 2008 Sep;37(6):325-9. doi: 10.1259/dmfr/62591340.

12- Tadinada A, Mahdian M, Sheth S, Chandhoke TK, Gopalakrishna A, Potluri A, Yadav S. The reliability of tablet computers in depicting maxillofacial radiographic landmarks. Imaging Sci Dent. 2015;45(3):175-180. doi: 10.5624/isd.2015.45.3.175.

13- Araki K, Fujikura M, Sano T. Effect of display monitor devices on intra-oral radiographic caries diagnosis. Clin Oral Invest. 2015:19(8):1875–1879. doi: 10.1007/s00784-015-1401-z.

14- Kallio-Pulkkinen S, Haapea M, Liukkonen E, Huumonen S, Tervonen O, Nieminen MT. Comparison between DICOM-calibrated and uncalibrated consumer grade and 6-MP displays under different lighting conditions in panoramic radiography. Dentomaxillofac Radiol. 2015;44(5):1-7. doi: 10.1259/dmfr.20140365.

15- Miri S, Mehralizadeh S, Sadri D, Motamedi MRK, Soltani P. The efficacy of the reverse contrast mode in digital radiography for the detection of proximal dentinal caries. Imaging Sci Dent. 2015;45(3):141-145. doi: 10.5624/isd.2015.45.3.141.

16- Belém MDF, Ambrosano GMB, Tabchoury MCP, Ferreira-Santos RI, Haiter-Neto F. Performance of digital radiography with enhancement filters for the diagnosis of proximal caries. Braz Oral Res. 2013;27(3):245-251. doi: 10.1590/S1806-83242013000300004.

17- Ulusu T; Bodur H; Odabas ME. In vitro comparison of digital and conventional bitewing radiographs for the detection of approximal caries in primary teeth exposed and viewed by a new wireless handheld unit. Dentomaxillofacial Radiology (2010) 39, 91–94.

18- Vasconcelos TV, Santaella GM, Nascimento HA, Rovaris K, Ambrosano GM, Freitas DQ. Digital radiographs displayed on different devices: effect on the detection of vertical root fractures. Int Endod J. 2016 Apr;49(4):386-92. doi: 10.1111/iej.12466. Epub 2015 Jun 3.

19- Ilić DV, Stojanović L. Application of digital radiography for measuring in clinical dental practice. Srp Arh Celok Lek. 2015 Jan-Feb;143(1-2):16-22.

20- Hashem MA, Moore WS, Noujeim M, Deahl ST, Geha H, Mcmahan CA. Detection of class ii caries on the ipad with retina display. Gen Dent. 2015;63(4):56-60.

21- Tewes S, Rodt T, Marquardt S, Evangelidou E, Wacker FK, Von Falck C. Evaluation of the use of a tablet computer with a high-resolution display for interpreting emergency CT scans. Rofo. 2013;185(11):1063-1069. doi: 10.1055/s-0033-1350155.

22- John S, Poh ACC, Lim TCC, Chan EHY, Chong LR. The ipad tablet computer for mobile on-call radiology diagnosis? Auditing discrepancy in CT and MRI reporting. J Digit Imaging. 2012;25(5):628-634.

23- Caffery LJ, Armfield NR, Smith AC. Radiological interpretation of images displayed on tablet computers: a systematic review. Br J Radiol. 2015:88(1050):20150191. doi: 10.1259/bjr.20150191.

24- Edirisinghe, Y.; Crossette, M.; Accuracy of using a tablet device for the use of digital radiology manipulation and measurements. Journal MTM, 2012;1(2):23-27. doi: 10.7309/jmtm.14.

25- Fleiss JL, Levin B, Paik MC. Statistical methods for rates and proportions. New Jersey: John Wiley & Sons; 2003.
26- Terry GL, Noujeim M, Langlais RP, Moore WS, Prihoda TJ. A clinical comparison of extraoral panoramic and intraoral radiographic modalities for detecting proximal caries and visualizing open posterior interproximal contacts. Dentomaxillofac Radiol. 2016;45(4):20150159. doi: 10.1259/dmfr.20150159. Epub 2016 Feb 12.
27- Kallio-Pulkkinen S, Huumonen S, Haapea M, Liukkonen E, Sipola A, Tervonen O, Nieminen MT. Effect of display type, DICOM calibration and room illuminance in bitewing radiographs. Dentomaxillofac Radiol. 2016;45(1):20150129. doi: 10.1259/dmfr.20150129
28- Kallio-Pulkkinen S, Haapea M, Liukkonen E, Huumonen S, Tervonen O, Nieminen MT. Comparison of consumer grade, tablet and 6MP-displays: observer performance in detection of anatomical and pathological structures in panoramic radiographs. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014 Jul;118(1):135-41. doi: 10.1016/j.oooo.2014.04.005. Epub 2014 Apr 19.
29- Takeshita WM, Iwaki LV, Da Silva MC, Sabio S, Albino PF. Comparison of periapical radiography with cone beam computed tomography in the diagnosis of vertical root fractures in teeth with metallic post. J Conserv Dent. 2014;17(3):225-229. doi: 10.4103/0972-0707.131781.
30- Wenzel A, Hintze H, Kold LM, Kold S. Accuracy of computer-automated caries detection in digital radiographs compared with human observers. Eur J Oral Sci. 2002;110(3):199-203.
31- Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-174.
32- Pakkala T, Kuusela L, Ekholm M, Wenzel A, Haiter-Neto F, Kortesniemi M. Effect of varying displays and room illuminance on caries diagnostic accuracy in digital dental radiographs. Caries Res. 2012;46(6):568-74. doi: 10.1159/000341218. Epub 2012 Aug 28.
33- Haak R, Wicht MJ, Nowak G, Hellmich M. Influence of displayed image size on radiographic detection of approximal caries. Dentomaxillofac Radiol. 2003 Jul;32(4):242-6.

Table 1 - Display specifications.

	Pavilion dm 1 (control)	iPhone 6s	Gran Duos 2	iPad	Samsung Tab
Inches	15.6”	4.7”	5.25”	9.7”	7”
Resolution	1920 × 1080 pixels	1334 × 750 pixels	1280 × 720 pixels	2048 × 1536 pixels	1024 × 600 pixels
PPI	137.7	326	280	264	170
Type	LCD	LCD	TFT LCD	LED	TFT LCD

Table 2–Kappa coefficients (κ) representing the intra- and inter-examiner evaluations.

	Intra-examiner		Inter-examiner
	Observer 1	Observer 2	Observer 1 × Observer 2
Control	0.928	0.797	0.809
iOS Smartphone	1.000	0.783	0.794
Android Smartphone	0.800	0.783	0.761
iOS Tablet	1.000	0.737	0.799
Android Tablet	1.000	0.783	0.899

Table 3–Display type, area under the receiver operating characteristic (ROC) curve (AUC), mean values, and 95% confidence interval (observer 1 and 2).

Displays	AUC mean		Standard error		95% Confidence interval	
Observer	1	2	1	2	1	2
Control	0.935	0.961	0.031	0.025	0.864 to 0.976	0.898 to 0.990
iOS Smartphone	0.935	0.953	0.031	0.027	0.864 to 0.976	0.888 to 0.986
Android Smartphone	0.904	0.929	0.038	0.033	0.825 to 0.956	0.855 to 0.972
iOS Tablet	0.911	0.988	0.036	0.014	0.834 to 0.961	0.939 to 0.998
Android Tablet	0.936	0.961	0.031	0.024	0.864 to 0.976	0.899 to 0.990

Table 4 - Comparisons between the areas under the ROC curves of the different devices using the exact binomial test (P ≤ 0.05).

Displays	95% Confidence interval		(P-value)	
Observer	1	2	1	2
Control x Smartphone_iOS	−0.069 to 0.069	−0.058 to 0.073	1.000	0.828
Control x Smartphone_Android	−0.040 to 0.103	−0.040 to 0.104	0.392	0.382
Control x Tablet_iOS	−0.055 to 0.103	−0.024 to 0.079	0.552	0.291
Control x Tablet_Android	−0.071 to 0.073	−0.056 to 0.057	0.977	0.978
Smartphone_iOS x Smartphone_Android	−0.029 to 0.092	−0.028 to 0.077	0.312	0.355
Smartphone_iOS x Tablet_IOS	−0.034 to 0.082	−0.018 to 0.088	0.415	0.197
Smartphone_iOS x Tablet_Android	−0.062 to 0.064	−0.045 to 0.061	0.974	0.765
Smartphone_Android x Tablet_iOS	−0.063 to 0.078	−0.003 to 0.122	0.839	0.062
Smartphone_Android x Tablet_Android	−0.045 to 0.110	−0.029 to 0.094	0.415	0.297
Tablet_iOS x Tablet_Android	−0.059 to 0.109	−0.023 to 0.076	0.560	0.289

*P ≤ 0.05 statistically significant difference.

Table 5–Display type, area under the curve and 95% confidence interval (for all observers).

Displays	Mean area under the ROC curve (Az)	Standard error	95% Confidence interval
Control	0.948	0.020	0.906 to 0.975
iOS Smartphone	0.944	0.021	0.900 to 0.972
Android Smartphone	0.916	0.025	0.866 to 0.952
iOS Tablet	0.949	0.020	0.906 to 0.976
Android Tablet	0.950	0.020	0.907 to 0.976

Table 6 - Comparisons between the areas under the ROC curves of the different devices using the exact binomial test ($P \leq 0.05$) for all observers.

Image Device	95% Confidence interval	(P-value)
Control x Smartphone_iOS	−0.045 to 0.053	0.864
Control x Smartphone_Android	−0.020 to 0.085	0.224
Control x Tablet_iOS	−0.048 to 0.049	0.989
Control x Tablet_Android	−0.044 to 0.047	0.955
Smartphone_iOS x Smartphone_Android	−0.012 to 0.068	0.165
Smartphone_iOS x Tablet_iOS	−0.039 to 0.049	0.837
Smartphone_iOS x Tablet_Android	−0.036 to 0.047	0.790
Smartphone_Android x Tablet_iOS	−0.017 to 0.082	0.194
Smartphone_Android x Tablet_Android	−0.016 to 0.083	0.182
Tablet_iOS x Tablet_Android	−0.048 to 0.049	0.969

*$P \leq 0.05$ statistically significant difference.

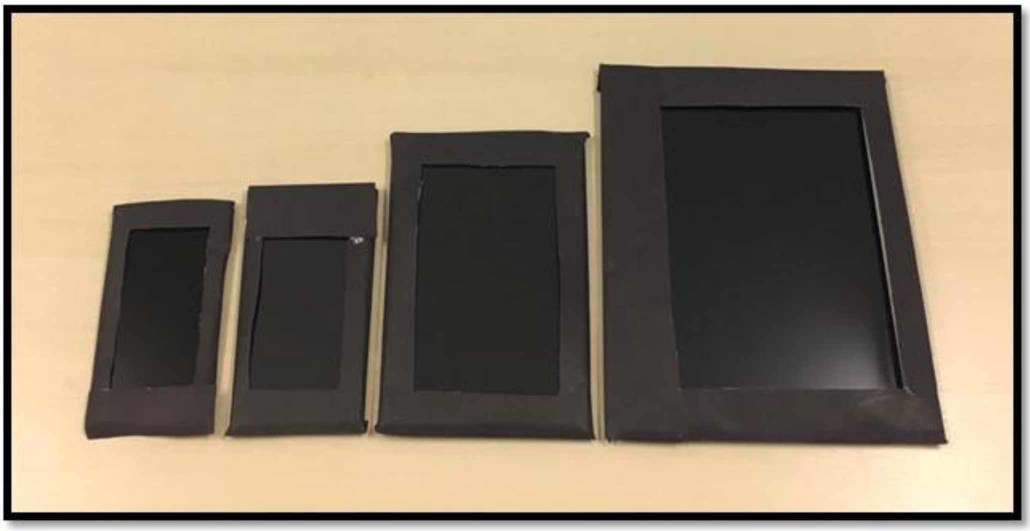


Figure 1: Displays with black cardboard.

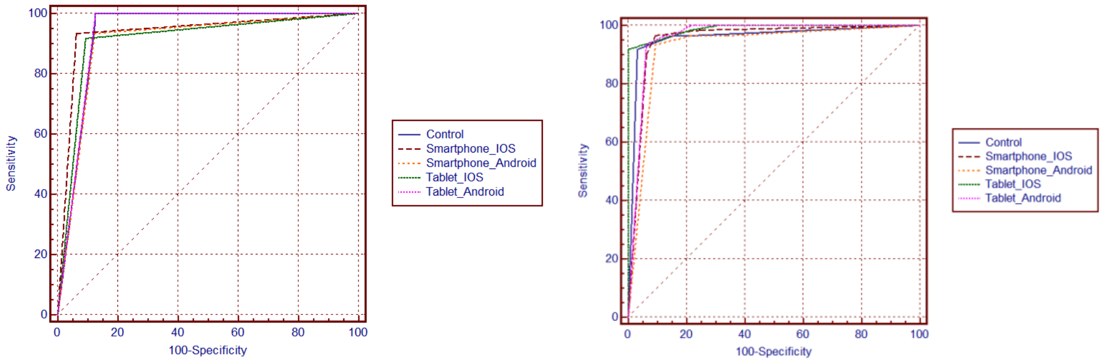


Figure 2 - ROC curve graph for different devices and observers 1 (2A) and 2 (2B).

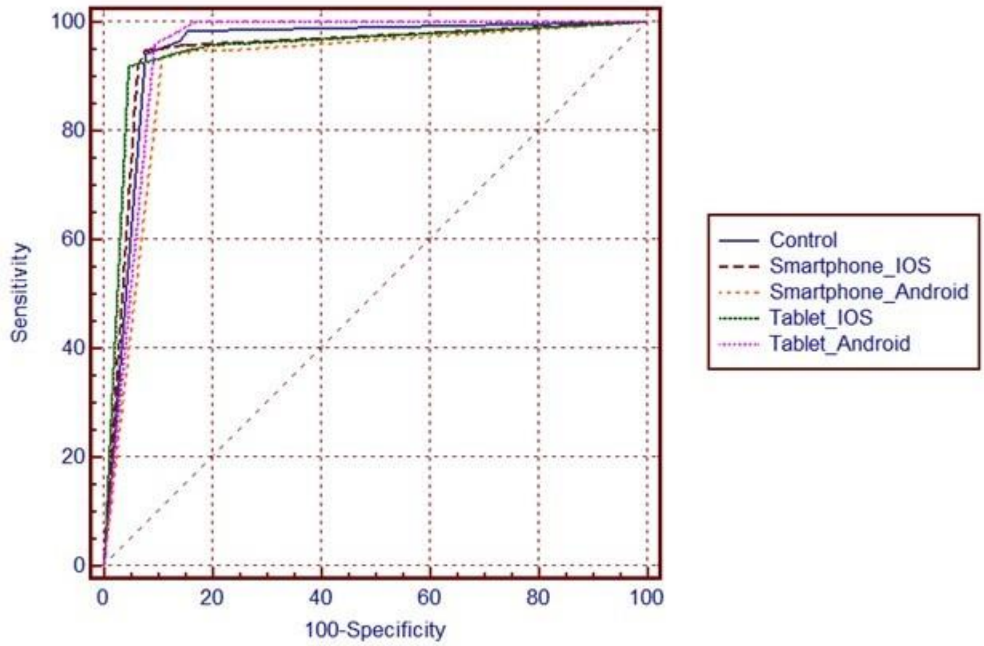


Figure 3 - ROC curve graph for different devices (combined ROC curves for all observers).

5- CONSIDERAÇÕES FINAIS

- Observamos que não existe diferença significativa entre os dispositivos testados. Podendo estes serem usados para visualização de lesões cariosas em radiografias digitais interproximais. Contudo novos estudos com outros tipos de alterações radiográficas devem ser realizados.
- Os trabalhos existentes na literatura comparam os dispositivos tablets, porém não foi encontrado trabalhos referentes a comparação de smartphones. Sugerimos então criação de novas pesquisa que aprofundem mais os estudos de outros dispositivos.
- O diagnóstico da cárie interproximal mostrou ser indiferente ao número de polegadas, resolução, PPI e tipo de tela. Sugerimos estudos de outras alterações radiográficas para ánalise da correlação dessas características com a acurácia diagnóstica.

6 – COMUNICADO DE IMPRENSA (PRESS RELEASE):

A radiografia digital trouxe inúmeros benefícios para a área da saúde, sendo algumas deles: menor tempo de exposição a radiação, capacidade de armazenamento e visualização de radiografias fora do ambiente clínico. Com a possibilidade de armazenamento de radiografias em computadores ou em arquivos nas nuvens, muitos profissionais das áreas da saúde poderiam ter acesso a essas imagens fora do ambiente clínico de trabalho.

Os pesquisadores da área de odontologia da Universidade Federal de Sergipe – UFS – Cristinne Andrade Melo e o Professor Doutor Wilton Mitsunari Takeshita juntamente com o Programa de Pós-graduação em Odontologia (Prodonto) da Universidade Federal de Sergipe, divulgaram resultado de pesquisa, na qual foi observado que a acurácia diagnóstica das radiografias interproximais digitais visualizando lesões cariosas em diferentes tipos de *displays*: *tablets e smartphones*. Novos testes deverão ser realizados englobando outras lesões orais para comprovar a eficácia diagnósticos de outros dispositivos *tablets e smartphones.*

REFERÊNCIAS

1. Abdinian M, Razavi SM, Faghihian R, Samety AA, Faghihian E. Accuracy of digital bitewing radiography versus different views of digital panoramic radiography for detection of proximal caries. J Dent (Tehran). 2015;12(4):290-297.
2. Araki K, Fujikura M, Sano T. Effect of display monitor devices on intra-oral radiographic caries diagnosis. Clin Oral Invest. 2015:19(8):1875–1879. doi: 10.1007/s00784-015-1401-z.
3. Belém MDF, Ambrosano GMB, Tabchoury MCP, Ferreira-Santos RI, Haiter-Neto F. Performance of digital radiography with enhancement filters for the diagnosis of proximal caries. Braz Oral Res. 2013;27(3):245-251. doi: 10.1590/S1806-83242013000300004.
4. Caffery LJ, Armfield NR, Smith AC. Radiological interpretation of images displayed on tablet computers: a systematic review. Br J Radiol. 2015:88(1050):20150191. doi: 10.1259/bjr.20150191.
5. Chinn CH, Levine J, Matos S, Findley S, Edelstein BL. An interprofessional collaborative approach in the development of a caries risk assessment mobile tablet application: My Smile Buddy. J Health Care Poor Underserved. 2013 Aug;24(3):1010-20.
6. Deprá LC, Vessoni Iwaki LC, Chicarelli M, Takeshita WM. Influence of image filters and variation in horizontal angle of incidence of x-ray beam in digital interproximal radiographs for diagnosis of secondary caries in esthetic restorations. J Contemp Dent Pract. 2015;16(10):805-812.
7. Edirisinghe, Y.; Crossette, M.; Accuracy of using a tablet device for the use of digital radiology manipulation and measurements. Journal MTM, 2012;1(2):23-27. doi: 10.7309/jmtm.14.
8. Fleiss JL, Levin B, Paik MC. Statistical methods for rates and proportions. New Jersey: John Wiley & Sons; 2003.
9. Haak R, Wicht MJ, Nowak G, Hellmich M. Influence of displayed image size on radiographic detection of approximal caries. Dentomaxillofac Radiol. 2003 Jul;32(4):242-6.

10. Hashem MA, Moore WS, Noujeim M, Deahl ST, Geha H, Mcmahan CA. Detection of class ii caries on the ipad with retina display. Gen Dent. 2015;63(4):56-60.
11. Ilić DV, Stojanović L. Application of digital radiography for measuring in clinical dental practice. Srp Arh Celok Lek. 2015 Jan-Feb;143(1-2):16-22.
12. John S, Poh ACC, Lim TCC, Chan EHY, Chong LR. The ipad tablet computer for mobile on-call radiology diagnosis? Auditing discrepancy in CT and MRI reporting. J Digit Imaging. 2012;25(5):628-634.
13. Kallio-Pulkkinen S, Haapea M, Liukkonen E, Huumonen S, Tervonen O, Nieminen MT. Comparison between DICOM-calibrated and uncalibrated consumer grade and 6-MP displays under different lighting conditions in panoramic radiography. Dentomaxillofac Radiol. 2015;44(5):1-7. doi: 10.1259/dmfr.20140365.
14. Kallio-Pulkkinen S, Haapea M, Liukkonen E, Huumonen S, Tervonen O, Nieminen MT. Comparison of consumer grade, tablet and 6MP-displays: observer performance in detection of anatomical and pathological structures in panoramic radiographs. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014 Jul;118(1):135-41. doi: 10.1016/j.oooo.2014.04.005. Epub 2014 Apr 19.
15. Kallio-Pulkkinen S, Huumonen S, Haapea M, Liukkonen E, Sipola A, Tervonen O, Nieminen MT. Effect of display type, DICOM calibration and room illuminance in bitewing radiographs. Dentomaxillofac Radiol. 2016;45(1):20150129. doi: 10.1259/dmfr.20150129.
16. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-174.
17. Li G, Berkhout WE, Sanderink GC, Martins M, van der Stelt PF. Detection of in vitro proximal caries in storage phosphor plate radiographs scanned with different resolutions. Dentomaxillofac Radiol. 2008 Sep;37(6):325-9. doi: 10.1259/dmfr/62591340.
18. Miri S, Mehralizadeh S, Sadri D, Motamedi MRK, Soltani P. The efficacy of the reverse contrast mode in digital radiography for the detection of proximal dentinal caries. Imaging Sci Dent. 2015;45(3):141-145. doi: 10.5624/isd.2015.45.3.141.

19. Nikneshan S, Abbas FM, Sabbagh S. Detection of proximal caries using digital radiographic systems with different resolutions. Indian J Dent Res. 2015;26(1):5-10. doi: 10.4103/0970-9290.156787.
20. Pakkala T, Kuusela L, Ekholm M, Wenzel A, Haiter-Neto F, Kortesniemi M. Effect of varying displays and room illuminance on caries diagnostic accuracy in digital dental radiographs. Caries Res. 2012;46(6):568-74. doi: 10.1159/000341218. Epub 2012 Aug 28.
21. Shintaku WH, Scarbecz M, Venturin JS. Evaluation of interproximal caries using the IPad 2 and a liquid crystal display monitor. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;113(5):40-44. doi: 10.1016/j.oooo.2011.11.008.
22. Tadinada A, Mahdian M, Sheth S, Chandhoke TK, Gopalakrishna A, Potluri A, Yadav S. The reliability of tablet computers in depicting maxillofacial radiographic landmarks. Imaging Sci Dent. 2015;45(3):175-180. doi: 10.5624/isd.2015.45.3.175.
23. Takeshita WM, Iwaki LC, Da Silva MC, Iwaki-Filho L, Queiroz AD, Geron LB. Comparison of the diagnostic accuracy of direct digital radiography system, filtered images, and subtraction radiography. Contemp Clin Dent. 2013;4(3):338-342. doi: 10.4103/0976-237X.118391.
24. Takeshita WM, Iwaki LV, Da Silva MC, Sabio S, Albino PF. Comparison of periapical radiography with cone beam computed tomography in the diagnosis of vertical root fractures in teeth with metallic post. J Conserv Dent. 2014;17(3):225-229. doi: 10.4103/0972-0707.131781.
25. Terry GL, Noujeim M, Langlais RP, Moore WS, Prihoda TJ. A clinical comparison of extraoral panoramic and intraoral radiographic modalities for detecting proximal caries and visualizing open posterior interproximal contacts. Dentomaxillofac Radiol. 2016;45(4):20150159. doi: 10.1259/dmfr.20150159. Epub 2016 Feb 12.
26. Tewes S, Rodt T, Marquardt S, Evangelidou E, Wacker FK, Von Falck C. Evaluation of the use of a tablet computer with a high-resolution display for interpreting emergency CT scans. Rofo. 2013;185(11):1063-1069. doi: 10.1055/s-0033-1350155.

27. Ulusu T; Bodur H; Odabas ME. In vitro comparison of digital and conventional bitewing radiographs for the detection of approximal caries in primary teeth exposed and viewed by a new wireless handheld unit. Dentomaxillofacial Radiology (2010) 39, 91–94.
28. Valizadeh S, Goodini M, Ehsani S, Mohseni H, Azimi F, Bakhshandeh H. Designing of a computer software for detection of approximal caries in posterior teeth. Iran J Radiol. 2015; 12(4): e16242. doi: 10.5812/iranjradiol.12(2)2015.16242.
29. Vasconcelos TV, Santaella GM, Nascimento HA, Rovaris K, Ambrosano GM, Freitas DQ. Digital radiographs displayed on different devices: effect on the detection of vertical root fractures. Int Endod J. 2016 Apr;49(4):386-92.
30. Vieira MS, Nogueira CPR, Silva MAS, Bauer JRO, Maia-Filho EM. In vitro evaluation of proximal carious lesions using digital radiographic systems. ScientificWorldJournal. 2015;2015:631508. doi: 10.1155/2015/631508.
31. Wenzel A, Hintze H, Kold LM, Kold S. Accuracy of computer-automated caries detection in digital radiographs compared with human observers. Eur J Oral Sci. 2002;110(3):199-203.
32. Xavier CRG, Araujo-Pires AC, Poleti ML, Rubira-Bullen IRF, Ferreira-Junior O, Capelozza ALA. Evaluation of proximal caries in images resulting from different modes of radiographic digitalization. Dentomaxillofac Radiol. 2011;40(6):338-343. doi: 10.1259/dmfr/67185962.
33. Yalçinkaya SE, Künzel A, Becker J. In vitro comparison of intraoral films and four image plate systems in radiographic caries diagnosis. Müsbed. 2012;2(4):175-180.

ANEXO A

HOSPITAL UNIVERSITÁRIO DE ARACAJÚ/ UNIVERSIDADE FEDERAL DE SERGIPE/ HU-

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: AVALIAÇÃO DA ACURÁCIA DIAGNÓSTICA DE ALTERAÇÕES CORONÁRIAS, RADICULARES E PERIAPICAIS EM DIFERENTES ¿DISPLAYS¿

Pesquisador: Wilton Mitsunari Takeshita

Área Temática:

Versão: 1

CAAE: 61992916.8.0000.5546

Instituição Proponente: FUNDACAO UNIVERSIDADE FEDERAL DE SERGIPE

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.873.299

Apresentação do Projeto:

Para auxiliar no diagnóstico das alterações coronárias, radiculares e periapicais têm-se as radiografias periapicais e interproximais. Com intuito de aprimorar a acurácia diagnóstica, foi desenvolvida a radiografia digital, a qual proporciona uma imagem com melhor qualidade e nitidez. Atualmente o uso da radiografia digital vem sofrendo evoluções, tais como, a possibilidade de visualização em dispositivos móveis, como exemplo, tablets e smartphones, por conta de sua disponibilidade, portabilidade e facilidade de uso. Deste modo, o objetivo da pesquisa será avaliar a acurácia diagnóstica de alterações coronárias, radiculares e periapicais em diferentes "displays". Para realização desta pesquisa serão utilizadas 50 radiografias digitais interproximais e 50 periapicais, selecionadas do arquivo do projeto de extensão: PJ025-2016 "Serviço de atendimento a pacientes com necessidade de exames radiográficos especializados." As imagens radiográficas serão analisadas por três radiologistas com mais de 10 anos de experiência em dois monitores LCD, dois monitores LED, dois smartphones: Iphone 6S (Apple, California, EUA) e Samsung Galaxy Gran 2 (DUOS) (Samsung, Seul, Coreia do Sul), e dois tablets: Ipad (Apple, California, EUA) e Samsung Galaxy Tab (Samsung, Seul, Coreia do Sul).

Endereço: Rua Cláudio Batista s/nº
Bairro: Sanatório CEP: 49.060-110
UF: SE Município: ARACAJU
Telefone: (79)2105-1805 E-mail: cephu@ufs.br

Continuação do Parecer: 1.873.299

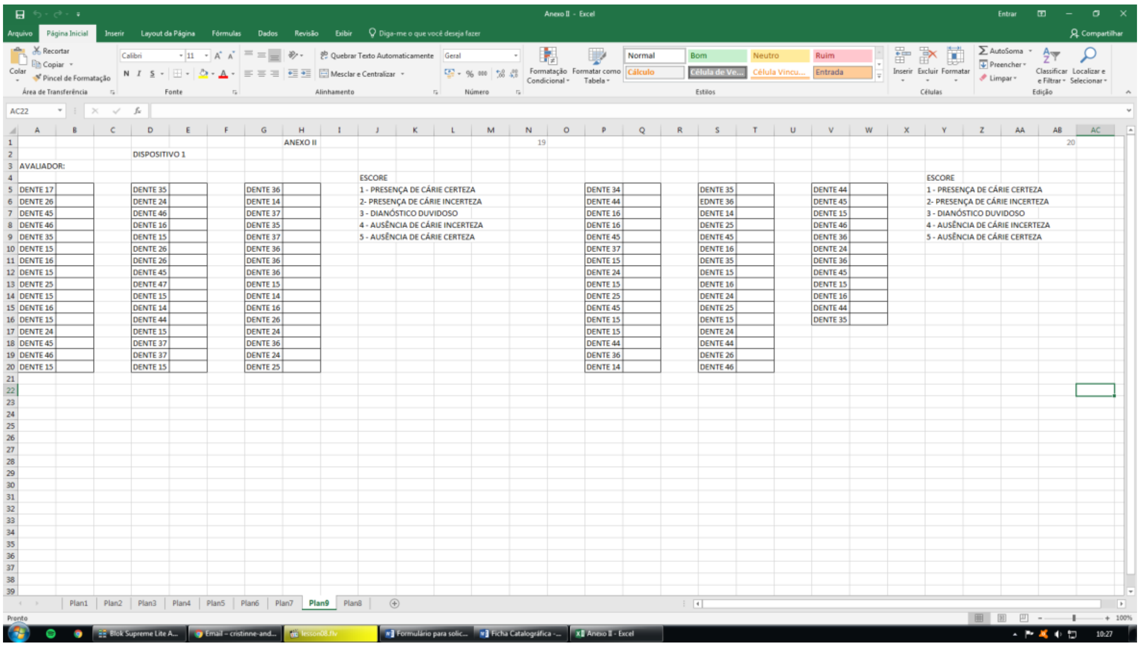
Folha de Rosto	Folha_de_rosto_assinada.pdf	03/11/2016 02:30:08	Wilton Mitsunari Takeshita	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

ARACAJU, 19 de Dezembro de 2016

APÊNDICE A



Linha	A	D	G	H	J	N	P	S	V	Y	AB
1				ANEXO II		19					20
2		DISPOSITIVO 1									
3	AVALIADOR:										
4					ESCORE					ESCORE	
5	DENTE 17	DENTE 35	DENTE 36		1 - PRESENÇA DE CÁRIE CERTEZA		DENTE 34	DENTE 35	DENTE 44	1 - PRESENÇA DE CÁRIE CERTEZA	
6	DENTE 26	DENTE 24	DENTE 14		2- PRESENÇA DE CÁRIE INCERTEZA		DENTE 44	EDNTE 36	DENTE 45	2- PRESENÇA DE CÁRIE INCERTEZA	
7	DENTE 45	DENTE 46	DENTE 37		3 - DIANÓSTICO DUVIDOSO		DENTE 16	DENTE 14	DENTE 15	3 - DIANÓSTICO DUVIDOSO	
8	DENTE 46	DENTE 16	DENTE 35		4 - AUSÊNCIA DE CÁRIE INCERTEZA		DENTE 16	DENTE 25	DENTE 46	4 - AUSÊNCIA DE CÁRIE INCERTEZA	
9	DENTE 35	DENTE 15	DENTE 37		5 - AUSÊNCIA DE CÁRIE CERTEZA		DENTE 45	DENTE 45	DENTE 36	5 - AUSÊNCIA DE CÁRIE CERTEZA	
10	DENTE 15	DENTE 26	DENTE 36				DENTE 37	DENTE 16	DENTE 24		
11	DENTE 16	DENTE 26	DENTE 36				DENTE 15	DENTE 35	DENTE 36		
12	DENTE 15	DENTE 45	DENTE 36				DENTE 24	DENTE 15	DENTE 45		
13	DENTE 25	DENTE 47	DENTE 15				DENTE 15	DENTE 16	DENTE 15		
14	DENTE 15	DENTE 15	DENTE 14				DENTE 25	DENTE 24	DENTE 16		
15	DENTE 16	DENTE 14	DENTE 16				DENTE 45	DENTE 25	DENTE 44		
16	DENTE 15	DENTE 44	DENTE 26				DENTE 15	DENTE 15	DENTE 35		
17	DENTE 24	DENTE 15	DENTE 24				DENTE 15	DENTE 24			
18	DENTE 45	DENTE 37	DENTE 36				DENTE 44	DENTE 44			
19	DENTE 46	DENTE 37	DENTE 24				DENTE 36	DENTE 26			
20	DENTE 15	DENTE 15	DENTE 25				DENTE 14	DENTE 46			