

AVALIAÇÃO DA PRECISÃO DA ANÁLISE DE BOLTON REALIZADA POR IMAGENS EM 3D

Palavras-chave: Análise de Bolton. Imagens de modelos em 3D. Análise de modelos ortodônticos. Análise da discrepância de modelos em ortodontia. Análise de modelos em 3D.

Autores: Allefe Gabriel da Silva Melo, FOP – UNICAMP; Lívia Nadylena da Silva Lima, FOP - UNICAMP

Orientadora: Prof^(a). Dr^(a). Vania C V Siqueira, FOP - UNICAMP siqueira@fop.unicamp.br

Introdução / Objetivos:

O sucesso do tratamento ortodôntico depende do diagnóstico inicial apurado no qual a análise dos modelos de gesso das arcadas dentárias do/a paciente são considerados o padrão ouro auxiliando imensamente no planejamento de cada etapa da execução do tratamento. Com os avanços tecnológicos, a preferência da utilização dos modelos digitais ou virtuais aumentou, pois oferece benefícios como maior eficiência, economia de tempo para a realização das análises diagnósticas e melhor aproveitamento em armazenamento de dados. A análise da discrepância de Bolton é uma ferramenta diagnóstica frequentemente usada para avaliar a proporcionalidade dentária entre os dentes superiores e inferiores auxiliando o/a ortodontista na verificação de possíveis discrepâncias que possam dificultar a finalização do tratamento ortodôntico permitindo a eleição de estratégias mais específicas e individualizadas. Essa análise ajuda a identificar discrepâncias que podem afetar o tratamento ortodôntico, permitindo métodos mais personalizados. O presente estudo verificou, por meio de uma investigação da literatura, a precisão e a confiabilidade da análise da discrepância de Bolton realizada virtualmente em imagens em 3D em comparação com a realizada manualmente em modelos de gesso tradicionais. O material e a metodologia englobaram uma revisão integrativa da literatura científica e dos resultados obtidos de pesquisas prévias publicadas e inseridas nas plataformas de bases de dados virtuais Scopus, Lilacs, PubMed, Embase, Cochrane e Web Of Science nos últimos 10 anos abrangendo o período de 2013 a 2023 que auxiliassem responder a questão: A análise da discrepância de Bolton realizada virtualmente possui a mesma confiabilidade e precisão da realizada tradicionalmente em modelos em gesso? Os critérios de inclusão adotados foram: 1- no espaço de tempo de 2013 a 2023; 2- o emprego dos descritores: Ortodontia; imagens de modelos em 3D; análise de modelos; análise da discrepância dentária; 3- artigos oriundos de pesquisas originais englobando estudos experimentais e não experimentais publicados nos idiomas português Brasil, Inglês e espanhol disponibilizados gratuitamente. Inicialmente realizou-se a leitura dos títulos e seus resumos e após a leitura na íntegra de cada artigo foram selecionados e permaneceram na pesquisa apenas os artigos que se relacionavam ao tema proposto pelo presente estudo. Os critérios de exclusão adotados foram: pesquisas publicadas em período não estabelecido nos critérios de inclusão e pesquisas da área de Ortodontia que não abordassem o tema proposto do presente estudo.

Resultados e Discussão:

A busca resultou em 141 artigos, sendo 33 na PUBMED, 26 na SCOPUS, 1 na LILACS, 3 na COCHRANE, 34 na EMBASE e 44 na Web of Science. Após a remoção dos artigos duplicados, seguiu-se a leitura dos títulos e dos resumos com o propósito de identificar os artigos que se encontravam de acordo com os objetivos estabelecidos na pergunta norteadora.

Após a leitura analítica integral de cada um dos artigos, apenas 23 encontravam-se dentro dos critérios estabelecidos pela proposição do presente estudo.

Quadro 1- Bases de dados e estratégias de busca

Base de Dados	Estratégia de Busca
PubMed	imaging, three dimensional [MeSH Terms] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d imaging computer generated [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR Computer-Generated 3D Imaging [Title/Abstract] OR image 3d [Title/Abstract] OR image three dimensional [Title/Abstract] OR images 3 d [Title/Abstract] OR images three dimensional [Title/Abstract] OR imaging 3d [Title/Abstract] OR imaging computer generated 3d [Title/Abstract] OR imaging three dimensional [Title/Abstract] OR three dimensional image [Title/Abstract] OR three dimensional image [Title/Abstract] OR Three-Dimensional Images [Title/Abstract] AND orthodontics [MeSH Terms] OR Dental Casting Technique [Title/Abstract] OR Dental Casting Technic [Title/Abstract] OR Dental Casting Techniques [Title/Abstract] OR Dental Casting Technics [Title/Abstract] AND Bolton Analysis [Title/Abstract] OR Bolton discrepancy [Title/Abstract] OR Tooth size discrepancy [Title/Abstract] OR Orthodontic diagnosis [Title/Abstract]
Scopus	INDEXTERMS imaging AND three-dimensional OR TITLE-ABS-KEY 3D Image OR 3D Imaging OR 3-D Image OR 3-D Imaging OR 3D Imaging, Computer Generated OR 3D Imagings, Computer-Generated OR Computer Assisted Three Dimensional Imaging OR Computer-Assisted Three-Dimensional Imaging OR Computer-Generated 3D Imaging OR Computer-Generated 3D Imagings OR Image, 3-D OR Image, Three-Dimensional OR Images, 3-D OR Images, Three Dimensional OR Imaging, 3-D OR Imaging, Computer-Assisted Three Dimensional OR Imaging, Computer-Generated 3D OR Imaging, Three Dimensional OR Imaging, Three-Dimensional, Computer Assisted OR Imagings, 3-D OR Imagings, Computer-Assisted Three-Dimensional OR Imagings, Computer-Generated 3D OR Imagings, Three-Dimensional OR Three Dimensional Image OR Three-Dimensional Images OR Three Dimensional Imaging, Computer-Assisted AND INDEXTERMS Orthodontics OR TITLE-ABS-KEY Dental Casting Technique OR Casting Technics, Dental OR Casting Techniques, Dental OR Dental Casting Technic OR Techniques, Dental Casting OR Dental Casting Techniques OR Technic, Dental Casting OR Technics, Dental Casting OR Technique, Dental Casting OR Casting Technic, Dental OR Dental Casting Technics AND TITLE-ABS-KEY Bolton Analysis OR Bolton discrepancy OR Orthodontic analysis of arches OR Tooth size discrepancy OR Orthodontic diagnosis
Lilacs	mh:Imaging, Three-Dimensional wtw:3d image OR 3d imaging OR 3-d image OR 3-d imaging OR 3d imaging, computer-generated OR 3d imagings, computer generated OR computer assisted three dimensional imaging OR computer-assisted three-dimensional imaging OR computer-generated 3d imaging OR computer generated 3d imagings OR image, 3-d OR image, three-dimensional OR images, 3- d OR images, three-dimensional OR imaging, 3-d OR imaging, computer-assisted three-dimensional OR imaging, computer-generated 3d OR imaging, three dimensional OR imaging, three-dimensional, computer assisted OR imagings, 3-d OR imagings, computer-assisted three-dimensional OR imagings, computer generated 3d OR imagings, three-dimensional OR three dimensional image OR three-dimensional image OR three-dimensional images OR three-dimensional imaging, computer-assisted OR mh:Imaging, Three-Dimensional tw: dental casting technique OR casting technics, dental OR casting techniques, dental OR dental casting technic OR techniques, dental casting OR dental casting techniques OR technic, dental casting OR technics, dental casting OR technique, dental casting OR casting technic, dental OR “dental casting technics”) OR mh: Orthodontics tw: bolton analysis OR bolton discrepancy OR orthodontic analysis of arches OR tooth size discrepancy OR orthodontic diagnosis
Cochrane	imaging, three dimensional [MeSH Terms] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d imaging computer generated [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR Computer-Generated 3D Imaging [Title/Abstract] OR image 3d [Title/Abstract] OR image three dimensional [Title/Abstract] OR images 3d [Title/Abstract] OR images three dimensional [Title/Abstract] OR imaging 3d [Title/Abstract] OR imaging computer generated 3d [Title/Abstract] OR imaging three dimensional [Title/Abstract] OR three dimensional image [Title/Abstract] OR three dimensional image [Title/Abstract] OR Three-Dimensional Images [Title/Abstract] AND orthodontics [MeSH Terms] OR Dental Casting Technique [Title/Abstract] OR Dental Casting Technic [Title/Abstract] OR Dental Casting Techniques [Title/Abstract] OR Dental Casting Technics [Title/Abstract] AND Bolton Analysis [Title/Abstract] OR Bolton discrepancy [Title/Abstract] OR Tooth size discrepancy [Title/Abstract] OR Orthodontic diagnosis [Title/Abstract]

Embase	imaging, three dimensional [MeSH Terms] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d image [Title/Abstract] OR 3d imaging [Title/Abstract] OR 3d imaging computer generated [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR computer assisted three dimensional imaging [Title/Abstract] OR Computer-Generated 3D Imaging [Title/Abstract] OR image 3d [Title/Abstract] OR image three dimensional [Title/Abstract] OR images 3d [Title/Abstract] OR images three dimensional [Title/Abstract] OR imaging 3d [Title/Abstract] OR imaging computer generated 3d [Title/Abstract] OR imaging three dimensional [Title/Abstract] OR three dimensional image [Title/Abstract] OR three dimensional image [Title/Abstract] OR Three-Dimensional Images [Title/Abstract] AND orthodontics [MeSH Terms] OR Dental Casting Technique [Title/Abstract] OR Dental Casting Technic [Title/Abstract] OR Dental Casting Techniques [Title/Abstract] OR Dental Casting Technics [Title/Abstract] AND Bolton Analysis [Title/Abstract] OR Bolton discrepancy [Title/Abstract] OR Tooth size discrepancy [Title/Abstract] OR Orthodontic diagnosis [Title/Abstract]
Web of Science	TS = imaging, three dimensional OR TI = 3d image OR TI = 3d imaging OR TI = 3d image OR TI = 3d imaging computer generated OR TI = computer assisted three dimensional imaging OR TI = computer assisted three dimensional imaging OR TI= Computer-Generated 3D Imaging OR TI = image 3d OR TI = image three dimensional OR TI = images 3d OR TI = images three dimensional OR TI = imaging 3d OR TI = imaging computer generated 3d OR TI = imaging three dimensiona OR TI = three dimensional image OR TI = three dimensional image OR TI = Three-Dimensional Images AND TS = orthodontics OR TI = Dental Casting Technique OR TI = Dental Casting Technic OR TI = Dental Casting Techniques OR TI = Dental Casting Technics AND TI = Bolton Analysis OR TI = Bolton discrepancy OR TI = Tooth size discrepancy OR TI = Orthodontic diagnosis

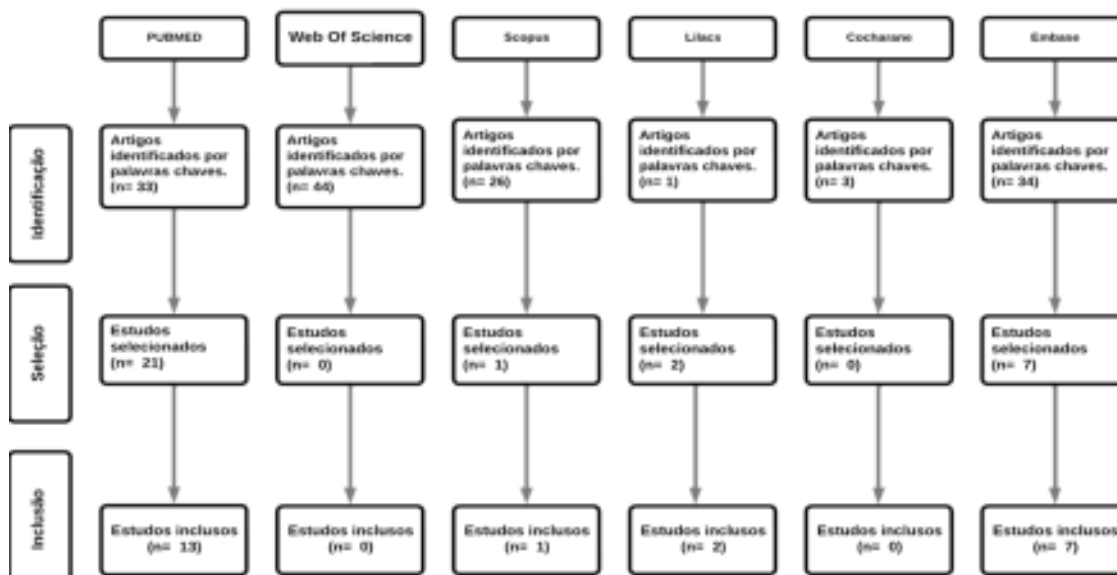


Figura 1. Fluxograma da inclusão de artigos

Conclusões:

A presente revisão integrativa da literatura permitiu verificar que a análise de discrepância de Bolton, quando realizada em modelos virtuais tridimensionais, demonstrou ser tão confiável quanto quando conduzida em modelos dentários convencionais. Os pesquisadores enfatizaram que os modelos digitais estão gradualmente adquirindo aceitação como uma alternativa aos modelos tradicionais de gesso na prática ortodôntica, proporcionando uma opção válida para o diagnóstico e planejamento do tratamento de casos ortodônticos.

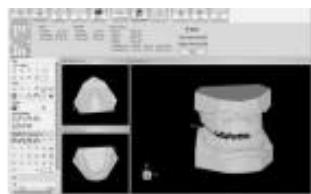


Figure 1. Screenshot of impacted scanned digital models using Ortho Insight 3D visualization software (Paragonware Software LLC., Houston, TX, USA).

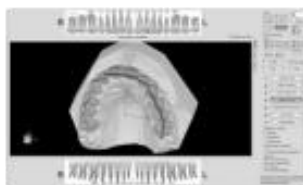
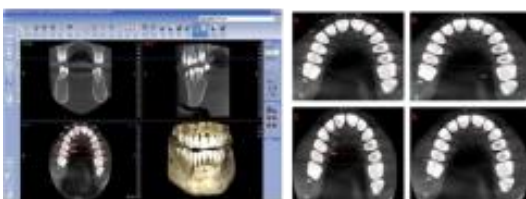


Figure 2. Impacted tooth with automatically calibrated after digital separation of the tooth and automatic facial axis detection using Ortho Insight 3D visualization software (Paragonware Software LLC., Houston, TX, USA).

Fonte das imagens: Kim J, Heo G, Lagravère MO.



Fonte das imagens: Sari Jose V, Bellot-Arcis C, Tamariza B, Zamora N, O Lagravere M, Paredes-Gallardo V



Fonte das imagens: Alan MK, Shahid F, Purral K, Ahmed B, Khamis MF

Referências Bibliográficas:

1. Abizadeh, Neilufar, David R. Moles, Julian O'Neill, e Joseph H. Noar. 2012. "Digital versus Plaster Study Models: How Accurate and Reproducible Are They?" *Journal of Orthodontics* 39 (3): 151–59. <https://doi.org/10.1179/1465312512Z.00000000023>.
2. Alam, Mohammad Khursheed, Fazal Shahid, Kathiravan Purmal, Basaruddin Ahmad, e Mohd Fadhli Khamis. 2014. "Bolton Tooth Size Ratio and Its Relation with Arch Widths, Arch Length and Arch Perimeter: A Cone Beam Computed Tomography (CBCT) Study". *Acta Odontologica Scandinavica* 72 (8): 1047–53. <https://doi.org/10.3109/00016357.2014.946967>.
3. Aragón, Mónica L. C., Luana F. Pontes, Lívia M. Bichara, Carlos Flores-Mir, e David Normando. 2016. "Validity and reliability of intraoral scanners compared to conventional gypsum models measurements: a systematic review". *European journal of orthodontics* 38 (4): 429–34. <https://doi.org/10.1093/ejo/cjw033>.
4. Asquith, J. A., e G. T. McIntyre. 2012. "Dental Arch Relationships on Three-Dimensional Digital Study Models and Conventional Plaster Study Models for Patients with Unilateral Cleft Lip and Palate". *The Cleft Palate-Craniofacial Journal: Official Publication of the American Cleft Palate-Craniofacial Association* 49 (5): 530–34. <https://doi.org/10.1597/10-099>.
5. Brandão, Marianna Mendonca, Marcio Costal Sobral, e Carlos Jorge Vogel. 2015. "Reliability of Bolton analysis evaluation in tridimensional virtual models". *Dental press journal of orthodontics* 20 (5): 72–77. <https://doi.org/10.1590/2177-6709.20.5.072-077.oar>.
6. Celikoglu, Mevlut, Metin Nur, Dogan Kilkis, Omer Said Sezgin, e Mehmet Bayram. 2013. "Mesiodistal Tooth Dimensions and Anterior and Overall Bolton Ratios Evaluated by Cone Beam Computed Tomography". *Australian Orthodontic Journal* 29 (2): 153–58.
7. De Luca Canto, G., C. Pachêco-Pereira, M. O. Lagravere, C. Flores-Mir, e P. W. Major. 2015. "Intra-Arch Dimensional Measurement Validity of Laser-Scanned Digital Dental Models Compared with the Original Plaster Models: A Systematic Review". *Orthodontics & Craniofacial Research* 18 (2): 65–76. <https://doi.org/10.1111/ocr.12068>.
8. Gül Amuk, Nisa, Erol Karsli, e Gokmen Kurt. 2019. "Comparison of Dental Measurements between Conventional Plaster Models, Digital Models Obtained by Impression Scanning and Plaster Model Scanning". *International Orthodontics* 17 (1): 151–58. <https://doi.org/10.1016/j.ortho.2019.01.014>.
9. Kapila, S. D., e J. M. Nervina. 2015. "CBCT in Orthodontics: Assessment of Treatment Outcomes and Indications for Its Use". *Dento Maxillo Facial Radiology* 44 (1): 20140282. <https://doi.org/10.1259/dmfr.20140282>.
10. Kenkare, Priyanka, Shravan Shetty, Utkarsh Mangal, Ashith Mv, e Siddarth Shetty. 2021. "The Utilization of Three-Dimensional Technology for an Accurate Diagnosis and Precise Treatment Planning in the Field of Orthodontics". *Biomedical & Pharmacology Journal* 14 (4): 2101–7. <https://doi.org/10.13005/bpj/2307>.

11. Kim, Jooseong, Giseon Heo, e Manuel O. Lagravère. 2014. “Accuracy of Laser-Scanned Models Compared to Plaster Models and Cone-Beam Computed Tomography”. *The Angle Orthodontist* 84 (3): 443–50. <https://doi.org/10.2319/051213-365.1>.
12. Kim, Jooseong, e Manuel O. Lagravère. 2016. “Accuracy of Bolton Analysis Measured in Laser Scanned Digital Models Compared with Plaster Models (Gold Standard) and Cone-Beam Computer Tomography Images”. *Korean Journal of Orthodontics* 46 (1): 13–19. <https://doi.org/10.4041/kjod.2016.46.1.13>.
13. Kustrzycka, Dorota, Tim Marschang, Marcin Mikulewicz, e Wojciech Grzebieluch. 2020. “Comparison of the Accuracy of 3D Images Obtained from Different Types of Scanners: A Systematic Review”. *Journal of Healthcare Engineering* 2020: 1–7. <https://doi.org/10.1155/2020/8854204>.
14. Nalcaci, Ruhi, Tolga Topcuoglu, e Firat Ozturk. 2013. “Comparison of Bolton Analysis and Tooth Size Measurements Obtained Using Conventional and Three-Dimensional Orthodontic Models”. *European Journal of Dentistry* 7 (Suppl 1): S066–70. <https://doi.org/10.4103/1305-7456.119077>.
15. Rossini, Gabriele, Simone Parrini, Tommaso Castrolforio, Andrea Deregibus, e Cesare L. Debernardi. 2016. “Diagnostic Accuracy and Measurement Sensitivity of Digital Models for Orthodontic Purposes: A Systematic Review”. *American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics* 149 (2): 161–70. <https://doi.org/10.1016/j.ajodo.2015.06.029>.
16. San Jose, V., C. Bellot-Arcis, B. Tarazona, N. Zamora, M. O Lagravere, e V. Paredes-Gallardo. 2017. “Dental measurements and Bolton index reliability and accuracy obtained from 2D digital, 3D segmented CBCT, and 3d intraoral laser scanner”. *Journal of clinical and experimental dentistry*, 0–0. <https://doi.org/10.4317/jced.54428>.
17. Sfondrini, Maria Francesca, Paola Gandini, Maurizio Malfatto, Francesco Di Corato, Federico Trovati, e Andrea Scribante. 2018. “Computerized casts for orthodontic purpose using powder-free intraoral scanners: Accuracy, execution time, and patient feedback”. *BioMed research international* 2018: 1–8. <https://doi.org/10.1155/2018/4103232>.
18. Suryajaya, William, Maria Purbiati, e Nada Ismah. 2021. “Accuracy of Digital Dental Models and Three-Dimensional Printed Dental Models in Linear Measurements and Bolton Analysis”. *F1000Research* 10: 180. <https://doi.org/10.12688/f1000research.31865.2>.
19. Tarazona, B., J. M. Llamas, R. Cibrian, J. L. Gandia, e V. Paredes. 2013. “A Comparison between Dental Measurements Taken from CBCT Models and Those Taken from a Digital Method”. *European Journal of Orthodontics* 35 (1): 1–6. <https://doi.org/10.1093/ejo/cjr005>.
20. Tarazona, Beatriz, José-María Llamas, Rosa Cibrián, José-Luis Gandía, e Vanessa Paredes. 2012. “Evaluation of the Validity of the Bolton Index Using Cone-Beam Computed Tomography (CBCT)”. *Medicina Oral, Patología Oral y Cirugía Bucal* 17 (5): e878-83. <https://doi.org/10.4317/medoral.18069>.
21. Waard, Olivier de, Frits Andreas Rangel, Piotr Stanislaw Fudalej, Ewald Maria Bronkhorst, Anne Marie Kuijpers-Jagtman, e Karel Hero Breuning. 2014. “Reproducibility and Accuracy of Linear Measurements on Dental Models Derived from Cone-Beam Computed Tomography Compared with Digital Dental Casts”. *American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics* 146 (3): 328–36. <https://doi.org/10.1016/j.ajodo.2014.05.026>.
22. Wiranto, Matthew G., W. Petrie Engelbrecht, Heleen E. Tutein Nolthenius, W. Joerd van der Meer, e Yijin Ren. 2013. “Validity, Reliability, and Reproducibility of Linear Measurements on Digital Models Obtained from Intraoral and Cone-Beam Computed Tomography Scans of Alginate Impressions”. *American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics* 143 (1): 140–47. <https://doi.org/10.1016/j.ajodo.2012.06.018>.
23. Yılmaz, Hakan, Fethiye Çakmak Özlü, Carmen Karadeniz, e Ersan İlsay Karadeniz. 2019. “Efficiency and Accuracy of Three-Dimensional Models versus Dental Casts: A Clinical Study”. *Turkish Journal of Orthodontics* 32 (4): 214–18. <https://doi.org/10.5152/TurkJOrthod.2019.19034>.