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Evaluation of efficacy of digital or virtual bite registration over conventional techniques- A systematic review

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ABSTRACT

Background: Bite registration procedures have been transformed by the digital revolution in dentistry, thus it is now necessary to compare the accuracy of digital or virtual techniques to conventional ones.

Aim: To assess the accuracy of digital or virtual bite registration systems in comparison to conventional methods to clarify any potential advantages or disadvantages.

Methodology: A thorough search in numerous databases, including PubMed, Embase, the Cochrane Library, Scopus, and Web of Science, was carried out in accordance with PRISMA criteria. The review focused on the accuracy of digital or virtual bite registration and covered a variety of study formats, including randomized controlled trials, clinical studies, and in-vitro investigations. For each of the included 7 studies, a thorough assessment of bias was conducted using the Newcastle-Ottawa Scale and the Cochrane Risk of Bias tool. As there would be expected variability in study designs, data synthesis required both a narrative explanation of the results and a qualitative synthesis.

Results: This systematic review compared 7 studies on traditional bite registration methods versus digital/virtual techniques. Digital techniques highlighted improved efficiency and innovation with increased speed, accuracy, and integration advantages. Evaluations performed with the Newcastle-Ottawa Scale and ROBINS-I tool showed little bias in cross-sectional studies. Nevertheless, in vitro studies have identified biases in participant selection and result reporting, indicating a need for better study rigor and reporting standards. A study received a noteworthy 8 out of 9 score on the Newcastle-Ottawa Scale, indicating strong methodology with careful sample selection, solid comparability, and comprehensive outcome evaluation, enhancing its credibility in assessing bite registration techniques.

Conclusion: The benefits of digital/virtual bite registration methods over traditional ones are demonstrated in this systematic review, which also shows how these methods improve speed, accuracy, and integration. Although some studies have shown biases, overall results support the validity and efficiency of digital techniques in improving dental practice.

1. INTRODUCTION

Digitization has brought about a significant change in dentistry, especially in bite registration, which is important for analyzing occlusion and creating prostheses. This research analyzes the precision of digital bite registration in comparison to conventional techniques, emphasizing possible advantages and disadvantages. The bite registration step records the relationship between the upper and lower tooth arches, important in prosthetics, orthodontics, and analyzing occlusion. In the past, professionals used substances such as silicone or wax, which

gave important information for treatment planning and making prostheses. Nevertheless, the digital era presents fresh chances for dental experts. Digital impressions, made possible by intraoral scanners and CAD/CAM systems, offer a less invasive and possibly more precise option compared to traditional techniques.^{1,2} These instruments record dental arches in 3D, generating a digital replica for editing and analysis.

Intraoral scanners and specialized software are utilized in digital bite registration to generate a 3D model of a patient's bite relationship. Methods consist of intraoral scanners equipped with bite splints, intraoral scanners with scan bodies, facial scanners with bite forks, and

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cone beam computed tomography (CBCT) scans. These methods provide a range of advantages, such as improved patient comfort and reduced number of appointments in the dental chair.³ Progress in 3D printing and materials research has simplified the production of precise dental prostheses. Still, the main inquiry persists: *Do these digital procedures have the same level of accuracy as conventional techniques?* The advancement of digital technologies in dentistry has had a major effect on bite registration techniques. Virtual occlusal records have been positively compared to traditional methods, emphasizing their similar levels of accuracy. Digital impressions are known for their ease and convenience, making dental procedures more efficient.^{1,2} In modern dental workflows, intraoral scanners are essential for providing detailed evaluations of dental anatomy and prosthetic fit. Research has extensively examined the factors that impact the precision of intraoral scanners, highlighting the importance of improving digital bite registration techniques.^{3,4} Clinical utilization of dental CAD/CAM systems highlights their efficiency in networked dentistry, enabling more efficient processes and improved treatment results. Selecting the right materials for bite registrations is crucial as it impacts the stability and precision of interocclusal recordings.^{5,6} Research on loading forces show their influence on vertical accuracy, which is essential for prosthetic dentistry purposes.⁷ Digital models of the mouth that simulate how teeth come together can revolutionize how dentists plan treatments and design prosthetics.⁸ The attitudes of dental professionals towards adopting digital technology in clinical practice present challenges and motivations. A detailed examination of dental CAD/CAM technology reveals its potential to significantly improve bite registration processes in modern dentistry by enhancing precision and efficiency.^{9,10} These research studies emphasize how technological advancements are changing the way bite registration is done in dentistry, improving precision, speed, and patient treatment. Numerous studies have investigated the effectiveness and precision of digital or virtual bite registration methods in comparison to traditional techniques. DeLong et al. (2002) found that virtual dental patients had similar maximum intercuspal contacts as mounted dental casts, although they did not specifically evaluate bite registration techniques.¹¹ The field of dentistry has been transformed by digital technologies, outpacing conventional techniques with notable improvements in bite registration. Virtual articulators have improved computer-aided methods for evaluating occlusal contact points.⁴ Research using 3D imaging consistently shows improved precision in assessing occlusal contacts, highlighting the accuracy possible with digital methods.^{6,7} Comparisons of traditional mounted dental models with digital 3D models have revealed new virtual alignment techniques, showing great advancements in digital methods.

The impact of loading forces on interocclusal records and the dimensional stability of recording materials has given important insights into the appropriateness of both traditional and digital materials. Studies have also investigated the incorporation of digital technologies in dental clinics, focusing on the obstacles and incentives for implementation. Assessments using 3D digital models demonstrate the flexibility and usefulness of digital methods in various types of malocclusion.^{8,9} Studies comparing traditional and digital techniques for capturing occlusion consistently demonstrate similar precision, confirming the efficacy of digital technology in this field.^{10–15} Furthermore, digital scans inside the oral cavity have shown better results in comparison to conventional methods, underscoring the benefits of digital over analog techniques.¹⁶ In-depth evaluations of intraoral scanners have emphasized their importance in achieving accurate digital bite registration. Research has shown that T-scan and 3D intraoral scanning are reliable and valid methods for measuring occlusal contact areas, therefore supporting the accuracy of digital methods.^{17,18} The clinical effectiveness of digital bite registration has been supported by validating the usage of intraoral scanners for maxillo-mandibular registration and the accuracy of virtual interocclusal records.^{19,20} Continuous progress in digital dentistry is improving methods for enhancing the precision and speed of digital bite registration, thanks to enhanced designs of

reference points and upgraded methodologies.^{21–23} Some studies explore the latest developments in digital bite registration and inter-occlusal therapy which examine the accuracy and precision of these techniques in various clinical contexts and technological contexts, emphasizing how they could improve dental treatments. Research looks at the accuracy differences between digital interocclusal records from different devices, evaluates the dependability of digital static inter-occlusal registration for thorough arch scans, and presents innovative methods for enhancing bite registration accuracy with intraoral scanners.^{24–26} Hence, this highlights how dental technology is developing to produce more accurate and effective clinical results.

The systematic review of digital bite registration in dentistry is crucial to thoroughly assess and merge existing research in this rapidly evolving area. With advancements in digital technologies like intraoral scanners and CAD/CAM systems, new options are emerging as replacements for traditional bite registration methods. Understanding the effectiveness, accuracy, and clinical relevance of digital methods compared to conventional techniques is crucial. This review aims to offer practitioners evidence-based insights into the benefits and drawbacks of digital bite registration by combining results from various studies on virtual articulators and advanced 3D imaging techniques. This compilation is crucial for guiding clinical practice and decision-making, aiding in the integration of advanced technologies that can greatly improve precision, patient results, and workflow efficiency in contemporary dental environments. In the end, the goal of the review is to give researchers and clinicians a thorough grasp of the advantages that digital bite registration can offer, leading to better patient care by making informed treatment decisions based on evidence.

2. Methodology

This systematic review meticulously integrates laboratory and clinical research, ensuring a comprehensive assessment of available literature. The methodical design, encompassing diverse study types, provided an extensive view of the efficacy of digital bite registration compared to traditional methods was conducted between the year 2000–2023. The primary research question of this review was, “*What was the accuracy of digital or virtual bite registration techniques compared to conventional methods in prosthodontics, orthodontics, and occlusal analysis?*”

2.1. Inclusion criteria

- Studies requiring bite registration in prosthodontics, orthodontics, or occlusal analysis.
- Studies investigating digital or virtual bite registration techniques.
- Studies reporting on the accuracy, efficiency, patient comfort, reproducibility, and clinical applicability of bite registration techniques
- Studies available in English within the time-period from 2000 to 2023.

2.2. Exclusion criteria

- Studies not directly comparing digital or virtual bite registration with conventional techniques.
- Pilot studies and non-peer-reviewed publications, including conference abstracts and proceedings.
- Case reports, reviews, editorials, commentaries, or opinion pieces.

2.3. PICOS questions

- Population (P): Dental procedures requiring bite registration for prosthodontics, orthodontics, or occlusal analysis.
- Intervention (I): Digital or virtual bite registration techniques.
- Comparison (C): Conventional bite registration techniques.

- Outcome (O): Accuracy of bite registration, efficiency, patient comfort, reproducibility, and clinical applicability.
- Study Design (S): Cross-sectional studies, in vitro studies, randomized controlled trials, and clinical trials published in peer-reviewed journals from 2000 to 2023.

The search strategy includes a combination of Medical Subject Headings (MeSH) terms and keywords, such as: “digital bite registration”, “virtual bite registration”, “conventional bite registration”, “accuracy”, “dental occlusion”, “dental technology”, “intraoral scanner”, “CAD/CAM”, “occlusal contact”, “systematic review”. A comprehensive search strategy was developed using relevant keywords and Medical Subject Headings (MeSH) terms. Databases such as PubMed, Embase, Cochrane Library, Scopus, and Web of Science were systematically searched for articles published up to the present date. The search included variations of terms such as “digital bite registration,” “virtual bite registration,” “conventional bite registration,” “prosthodontics,” “orthodontics,” “occlusal analysis,” “intraoral scanners,” “CAD/CAM systems,” “dental impressions,” “digital dentistry,” “3D printing,” “dental prosthesis,” “dental CAD/CAM technology,” “virtual articulators,” “dentistry technology adoption,” “dental practitioners,” “precision dentistry,” “dental materials,” “interocclusal recording,” and “bite registration accuracy.” (Table 1).

The review adheres to the PRISMA guidelines to ensure transparency and completeness in reporting the systematic review (Fig. 1). Out of a total of 138 articles, only 7 were found to be eligible for quantitative analysis and were included in the review process (Table 2). Three independent reviewers were crucial in providing a thorough and objective evaluation during the data gathering phase. Taking the lead in the initial screening phase, Reviewer 1 (PP) carefully examined the titles and abstracts of the selected publications in accordance with the preset inclusion and exclusion criteria. This required a comprehensive evaluation to find possibly pertinent studies that should be considered further. In this preliminary screening, Reviewers 2 (AD) and 3 and 4 (TB and SB) contributed equally, offering a range of view-points, and enhancing the overall precision of the research selection.

The three reviewers worked together to locate potential articles, then carefully read through the whole texts. Data extraction was carried out by each reviewer individually utilizing a standardized form created specifically for the review. Reviewer 1 (PP) made sure to have a thorough understanding of the research methodology used by concentrating on gathering information on study design. Reviewer 2 (AD) focused on the interventions and characteristics of the participants, going into detail about the populations that were examined and the therapies that were used. Reviewer 3 and 4 (TB and SB) oversaw gathering information on the outcomes and results, making sure that everyone understood the findings that were published.

Discrepancies inevitably surfaced while extracting the data. But there was a strong mechanism in place to reconcile these differences. To address any discrepancies in their evaluations, the four evaluators had in-depth conversations. By ensuring that judgments about the eligibility and data extraction of studies were made collaboratively, this strategy

Table 1
Search terms and Results from different databases.

S. No	Database searched	Search terms	Results
1	PubMed	((digital bite) OR (virtual bite)) AND (conventional bite) AND (Intra oral scanners) Filters: from 2000 - 2023	84
2	Embase	Digital bite, virtual bite, intraoral scanners, Filter: from 2000 - 2023	24
3	Cochrane	Virtual bite registration, intra oral scanner and Conventional bite registration	11
4	Scopus	Digital bite, virtual bite, intraoral scanners, Filter: from 2000 - 2023	5
5	Web of science	Virtual bite registration, intra oral scanner and Conventional bite registration	13

reduced the possibility of bias and improved the review’s dependability.

The four reviewers got back together after extracting their individual data to combine all the information that had been gathered. The task of crafting a narrative summary of the results, highlighting the essential elements of the study design, was spearheaded by Reviewer 1 (PP). Reviewer 2 (AD) helped to create a coherent narrative that contextualized the findings by tying together the participant characteristics and interventions. Reviewer 3 and 4 (TB and SB) contributed significantly to the synthesis by combining the findings and conclusions into an all-encompassing summary. Quantitative meta-analysis was conducted when possible, and the three reviewers worked together to use the right statistical techniques to ensure a thorough and fact-based synthesis of the data. The systematic review’s data collection, extraction, and synthesis phases were carried out with methodological rigor and transparency thanks to these cooperative efforts.

2.3.1. Three reviewers’ roles

- Reviewer 1 (PP): Responsible for the initial search and screening of titles and abstracts.
- Reviewer 2 (AD): Independently screens the titles and abstracts for relevance.
- Reviewer 3 and 4 (TB and SB): Acts as an arbitrator in case of disagreements between Reviewers 1 and 2.

The Cochrane Risk of Bias instrument and the Newcastle-Ottawa Scale were used to carefully assess the quality and risk of bias in the included studies. The Newcastle-Ottawa Scale ensures a thorough assessment of study quality by evaluating the outcome, comparability, and selection of non-randomized studies. The Cochrane Risk of Bias tool looked at blinding, random sequence generation, allocation concealment, and missing outcome data in randomized controlled trials. By using a dual strategy, the inquiry was conducted thoroughly and with reliability, which increased the validity and dependability of the conclusions of the systematic review of digital versus traditional bite registration procedures.

3. Results

The research in Table 2 highlights how digital/virtual bite registration techniques offer clear benefits over traditional methods. Solaberrieta et al. (2015) and Iwauchi et al. (2022) showed that both methods can produce precise outcomes, but digital approaches typically offer extra advantages like improved accuracy and consistency. Abdulateef et al. (2020) emphasized the clinical precision of virtual interocclusal records, supporting the accuracy of digital techniques. De Long et al. (2007) and Straga (2009) additionally confirmed the reliability of digital methods, especially in evaluating occlusal contact. These results indicate that digital bite registration is more accurate, consistent, and integrated compared to traditional methods, reflecting advancements in dental technology.

Table 3 shows that Solaberrieta E et al. (2015) conducted a study with overall robust methodological quality, based on the risk of bias assessment using the Newcastle-Ottawa Scale.¹ The research achieved a perfect score in the selection criteria, demonstrating a carefully chosen and diverse sample that was selected without any bias. It also successfully accounted for potential influences, receiving top scores in comparability. The result evaluation was strong with sufficient follow-up, leading to its high rating in the outcome category. In general, Solaberrieta E et al. (2015) obtained a score of 8 out of 9, indicating minimal bias and emphasizing the robust methodological approach in assessing digital and traditional bite registration methods.¹

The risk of bias assessment for the in vitro studies were assessed using the ROBINS- I tool, each study was examined under 7 domains. Remarkably, the study by Ghazal et al.⁷ scored the highest, closely followed by studies by Tejo et al. and Maruyama et al. Using the Newcastle

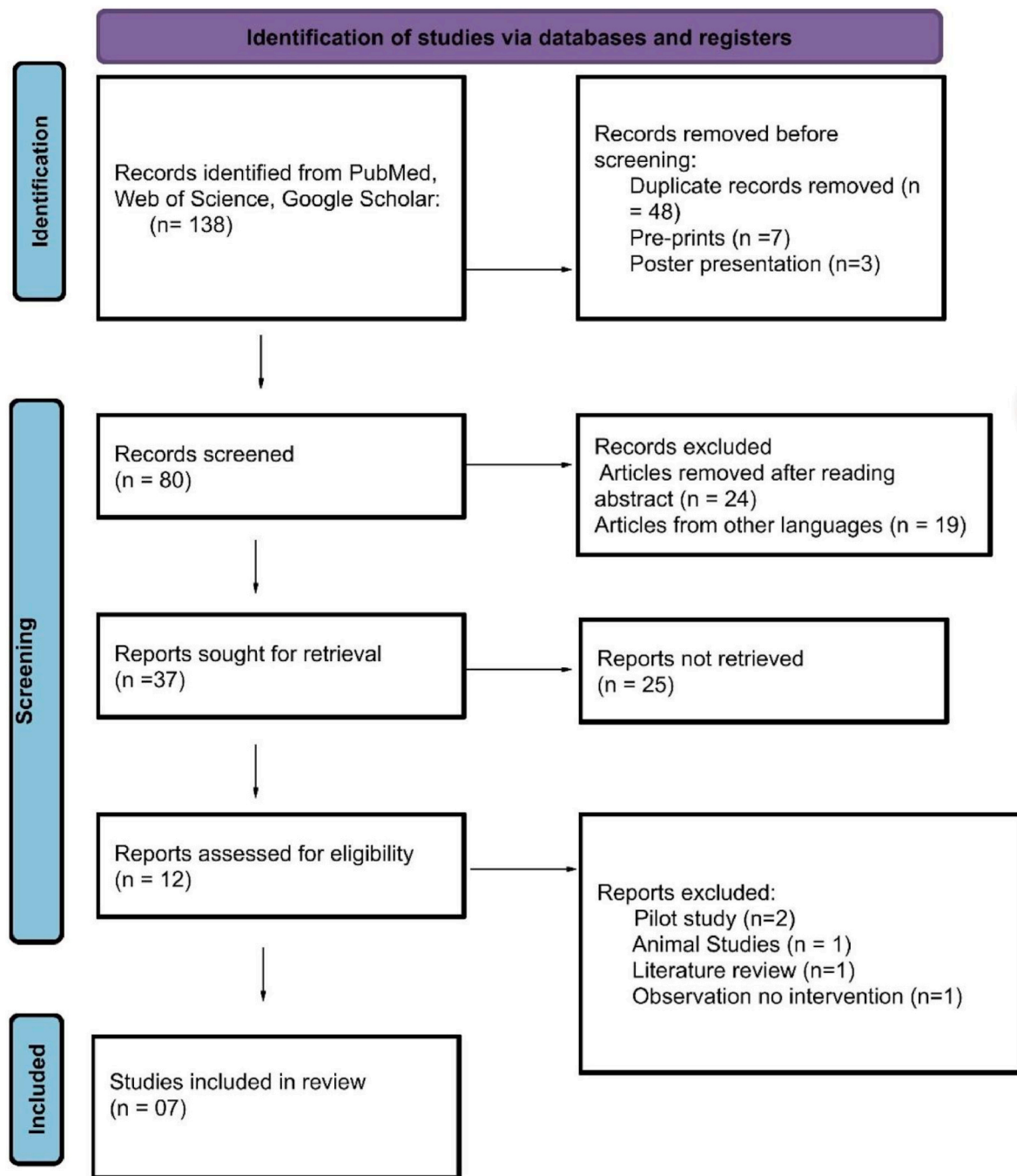


Fig. 1. PRISMA Flowchart for the review.

Ottawa Scale, a cross-sectional study by Solaberrieta et al. was evaluated based on seven criteria [Fig. 3], receiving an excellent score of eight.^{1,6,7}

The tool looked at each study based on 11 different factors. Interestingly, the study by Ghazal et al. showed the best score, demonstrating a strong technique.⁷ After then, the investigations carried out by Tejo et al. and Maruyama et al. also showed excellent results, indicating a good experimental design and data processing.^{6,12}

Figs. 2 and 3 highlights the meticulous method used in assessing the included studies by providing a visual representation of the risk of bias evaluation for the in vitro studies based on Cochrane’s ROBINS- I tool. Among the Studies included for the bias assessment, the study by Iwauchi Y et al. (2022) was found to be of least bias score and found to have a sound methodology and data assessment.²⁷ Study conducted by De Long et al. (2007) found to have the highest risk of bias score due to

lack of information about the selection of participants and bias in reported results.¹³ In addition, Solaberrieta et al.’s cross-sectional study was assessed using the Newcastle Ottawa Scale, which had seven different criteria (Table 3 & Fig. 4).¹ The study had an excellent score of 8 indicating that it was a well-conducted inquiry. These results demonstrate the cross-sectional study’s reliability in adding to the overall findings of the systematic review and validate its credibility based on the Newcastle Ottawa Scale. All things considered, the systematic review has effectively assessed the potential for bias among the included research, guaranteeing a thorough and trustworthy assessment of the precision of digital or virtual bite registration in contrast to traditional methods.

Table 2
Studies included in the present systematic review to compare the efficacy of digital/virtual vs conventional bite registration techniques.

Author & Year	Research Focus	Methodology	Use of digital or Conventional bite registration	Key Findings or Outcome
Solaberrieta E et al. (2015) ¹	Comparison of Occlusal Records	Comparison of virtual vs. conventional occlusal records	Both methods employed for occlusal records	The study compared conventional and virtual occlusal records, finding differences between the two methods.
Delong R et al. (2002) ¹¹	Intercuspal Contacts	Comparing maximum intercuspal contacts of virtual dental patients and mounted dental casts	Virtual dental patients and mounted dental casts	The research focused on comparing intercuspal contacts between virtual dental patients and mounted dental casts, providing insights into the differences.
Abdulateef S et al. (2020) ²¹	Clinical Accuracy	Clinical accuracy and reproducibility of virtual interocclusal records	Virtual interocclusal records	The study evaluated the clinical accuracy and reproducibility of virtual interocclusal records, offering insights into their precision
De Long R et al. (2007) ¹³	Accuracy of Contact	Accuracy of contacts calculated from 3D images of occlusal surfaces	3D images of occlusal surfaces	The research assessed the accuracy of contacts calculated from 3D images, contributing to the understanding of the precision of this method.
Straga RW (2009) ¹⁴	Occlusal Contacts	Comparison of occlusal contacts on mounted dental models to contacts identified on digital 3D models	Digital 3D models	The study compared occlusal contacts on mounted dental models with those on digital 3D models, introducing a new virtual alignment method.
Iwauchi Y et al. (2022) ²⁷	Interocclusal Registration	Clinical evaluation of the precision of interocclusal registration by using digital and conventional techniques	Both digital and conventional techniques	The research clinically evaluated the precision of interocclusal registration using both digital and conventional techniques, providing practical insights.
Ries JM et al. (2022) ²⁸	Accuracy of Registration	Three-dimensional analysis of the accuracy of conventional and completely digital interocclusal registration methods	Both conventional and completely digital methods	The research clinically evaluated the precision of interocclusal registration using both digital and conventional techniques, providing practical insights. The study conducted a three-dimensional analysis to assess the accuracy of both conventional and completely digital interocclusal registration methods.

Table 3
Risk of Bias Assessment for cross sectional study based on Newcastle Ottawa scale.

Study Name	Selection	Comparability	Outcome	Newcastle Ottawa Score
Solaberrieta et al. (2015) ¹	✓✓✓✓	✓✓	✓✓	8

4. Discussion

Digital dental technologies have significantly transformed the field by enhancing accuracy, efficiency, and patient comfort. For example, the use of virtual occlusal records demonstrates how digital advancements can streamline dental treatments and improve outcomes.¹ Digital

imprints have become increasingly important, improving patient satisfaction by reducing discomfort and expediting clinical procedures.² The variety of interocclusal recording materials remains crucial in modern dental practices, providing flexibility in different clinical scenarios.²⁹ The evolving role of digital imaging in orthodontics, particularly in grading systems, highlights technology’s impact on diagnostic accuracy.³⁰ Additionally, the emphasis on vertical precision in interocclusal records underscores the importance of meticulous processes for reliable data, especially under loading forces.⁷ The focus on the dimensional stability of interocclusal recording materials also supports more informed clinical decisions during procedures.⁶ Collectively, these technological advancements contribute to better patient care and more efficient clinical outcomes.

Seven researches were analysed thoroughly to assess the effectiveness of digital and virtual dentistry procedures to traditional bite

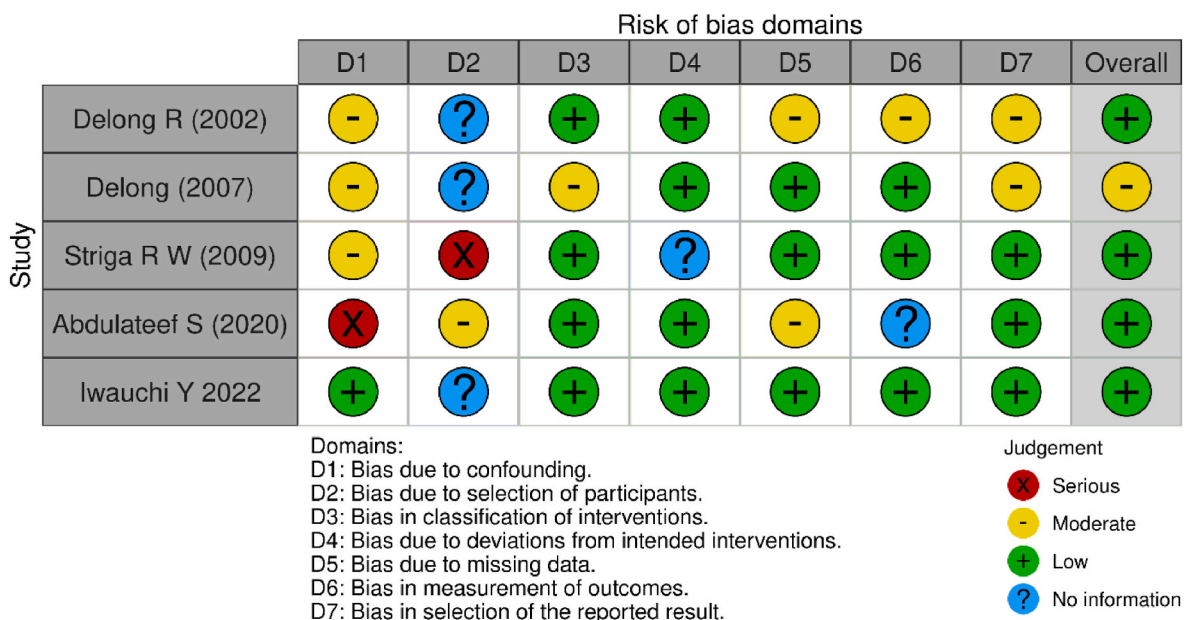


Fig. 2. Risk of bias for In vitro studies Based on ROBINS I tool.

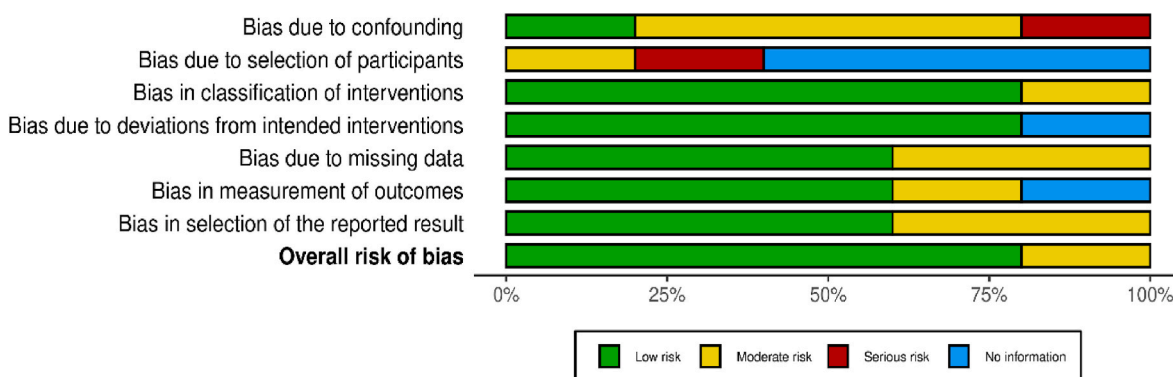


Fig. 3. Overall risk of bias for Invitro studies based on the ROBINS I tool.

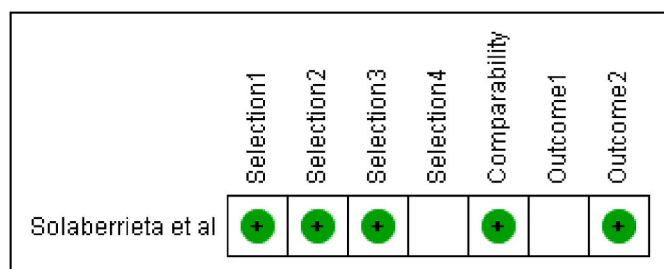


Fig. 4. Risk of bias for Cross sectional studies based on Newcastle Ottawa Scale.

registration methods in this systematic review. Both cross-sectional and in vitro researches were assessed using careful bias analyses to guarantee the validity of the results. Through a combination of data from Table 3, cross-sectional research, bias evaluations, and in vitro experiments, the goal is to shed light on how digital technologies are revolutionizing bite registration accuracy and productivity. The Office of Health Assessment and Translation tool’s risk of bias assessment identified notable findings in the in vitro investigations.

The most advanced evaluations found solid approaches and minimal bias in certain studies, with one 2022 study standing out for its strong methodology and rigorous data evaluation. These results offer valuable insights into technological advancements and the accuracy of dental measurements. Assessments with the Newcastle Ottawa Scale validated a crucial study, receiving a high score and showing thorough evaluation of outcome, comparability, and selection. Fig. 2 illustrates the bias evaluation of in vitro research, with one study standing out for having minimal bias. These findings greatly enhance knowledge of accuracy in bite registration techniques.

Computational techniques have significantly advanced precision measurements in dentistry, with a notable algorithm introduced for accurate Hausdorff distance estimates. Accurate digital data capturing is also crucial, as emphasized by studies highlighting the role of precise buccal scan methods in improving dental therapy outcomes. The investigation of dimensional accuracy in optical bite registration further underscores the importance of precise digital measurements for effective restorative treatments. The current review includes several studies demonstrating the accuracy of the digital bite registration process. It has been noticed that virtual articulators are quite effective, and that computer-aided determination leads to greater accuracy. The development of dental CAD/CAM technology over the last 20 years is underlined, with special attention paid to the digital impressions’ higher efficiency than traditional methods. Understanding the impact of loading pressures on interocclusal records and the qualification for networked dentistry through CAD/CAM technology are two contributions to the understanding of digital supremacy.

The transformative impact of intraoral scanners on productivity,

patient communication, accuracy, and overall quality has been highlighted, demonstrating their role in enhancing patient interactions and improving accuracy. The validation of digital bite registration’s speed and effectiveness compared to traditional analog techniques supports these advancements. This review integrates these insights, showcasing the revolutionary influence of digital techniques. The benefits of intraoral digital impressions in expediting treatments and enhancing patient experiences are well-documented. Furthermore, the review aligns with findings that highlight the significant changes brought about by digital tools in dentistry. Advances in intraoral scanning technology are also underscored by studies examining the precision of maxillo-mandibular registration using these scanners. The impact of computer-aided technology on dentistry is evident in the advancements in computer-aided occlusal contact point identification for dental 3-D CAD. Virtual technologies have proven capable of replicating real-world dental conditions, underscoring their value in simulating clinical situations. Recent refinements in interocclusal registration techniques have shown that both fully digital and traditional procedures can achieve accurate results. The increasing importance of digital techniques in dental assessments has been supported, highlighting the precision and consistency of T-scan and 3D intraoral scanning in determining occlusal contact areas. Thus, these studies demonstrate how dentistry is relying more and more on digital tools, and how continuous advancements in accuracy and precision are transforming dental procedures in the modern day. The efforts of numerous researchers have developed the digital dental environment, which is essential for better treatment outcomes and patient care. Digital tools are expected to be further integrated and offer improved dental treatment quality that will benefit both practitioners and patients. Thus, it can be deduced from the above study that with the advancement in the technological aspects pertaining to Dentistry, digital bite registration techniques are well-accepted, accessible, and easily applicable. Although certain constraints pertaining to technique sensitivity and cost efficiency, there remains concern, however, when it comes to the benefit of the patient and their satisfaction the clinicians should opt for a well-advanced technique whenever applicable. This review synthesizes various sources to highlight the advancements in digital dentistry and their impact on efficiency and accuracy in dental practices. Evidence indicates that digital methods outperform traditional techniques in obtaining precise bite registrations, which could revolutionize dental treatments and patient care. The review underscores the technological contributions to enhancing interocclusal registration and intraoral scanning accuracy, stressing the need for better training and standardized procedures. Digital bite registration techniques offer superior precision in capturing tooth contacts and jaw relationships, which enhances diagnostic accuracy and treatment planning. They eliminate the discomfort associated with traditional impression materials, improve patient comfort, and expedite procedures, reducing chair time. Additionally, digital scanning facilitates

smooth electronic data sharing with laboratories and specialists, leading to quicker treatment decisions and improved patient outcomes. Additionally, electronic storage allowed for the longevity of digital records, making them easily accessible for extended monitoring and integration with CAD/CAM technologies. Despite these advantages, obstacles included the upfront expense of technology, a learning curve for dentists, and restrictions in precision for specific patient demographics. Challenges were presented by problems such as data security, workflow integration, and the lack of tactile feedback during jaw manipulation. The systematic review recognized these constraints but highlighted the progress and benchmarks established by digital dental technologies for consistent and dependable results in prosthodontics.

5. Conclusion

In conclusion, this review effectively demonstrates the advantages of digital bite registration techniques over traditional methods. The analysis reveals that digital approaches offer superior accuracy, speed, and integration capabilities, significantly enhancing clinical efficiency and patient comfort. The systematic review of the included studies confirms that digital methods provide more precise interocclusal registrations and streamlined workflows. The evidence suggests that digital techniques will likely continue to advance the field of dentistry, leading to improved treatment outcomes and patient experiences. The comparative analysis underscores the need for further refinement and standardization in digital bite registration practices. The assessment of digital dental technologies underscores their transformative impact on modern dentistry. Integrating virtual occlusal records, digital impressions, and CAD/CAM systems enhances accuracy in diagnostics, treatment planning, and patient satisfaction. These tools improve tooth contact recording, streamline workflows, and facilitate better communication between professionals and labs, reducing chair time and yielding more reliable outcomes. Future advancements should focus on making digital tools user-friendly, affordable, and secure, with ongoing training and data protection improvements to further enhance patient care.

Prospero registration id

CRD42024523285.

Conflict of interest

No.

Ethical clearance

Ethical clearance was not required as this is not an in vivo study but a systematic review.

Patients' consent

Consent taking was not required as it is a systematic review based on completed studies.

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Declaration of competing interest

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

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