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Accuracy, Preference, Comfort, and Chairside Time Using Digital Intraoral Scanner in Children: A Scoping review

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Abstract: This study aims to evaluate the accuracy, preference, comfort, and impression-taking time of digital intraoral scanners in children. Literature was sourced from Scopus, ScienceDirect, Wiley, and PubMed (2014–2024). From 124 identified articles, 22 were duplicates, and 11 met the inclusion criteria and were assessed using the CEBM Appraisal Tools. These 11 articles were included in the final analysis. Data were organized following the PRISMA Extension for Scoping Reviews guidelines. **Results** of the 11 studies, 3 concluded that digital intraoral scanners are more accurate than conventional methods, 3 found equivalent accuracy, and 5 did not evaluate accuracy. Five articles showed children preferred the digital intraoral scanner over conventional methods, while 6 did not address preference. Regarding comfort, 5 articles reported that children felt more comfortable using the digital scanner, 1 article reported equal comfort, and 5 did not evaluate comfort. For impression-taking time, 1 article reported faster scanning times, 2 reported longer times, 2 found similar durations, and 6 did not discuss impression time. **Conclusion:** Scientific evidence regarding the use of digital intraoral scanners in children remains limited. While their accuracy is generally comparable to conventional methods, children tend to show better preference and comfort. However, findings related to impression-taking time vary, indicating a need for further research using standardized instruments to draw definitive conclusions.

Keywords: Dental impression procedure; Digital intraoral scanners; Pediatric dentistry

Introduction

The rapid advancement of digital technology has transformed various fields, including dentistry, particularly in dental impression techniques (Park et al., 2015; Róth et al., 2022). In pediatric dentistry, conventional methods using alginate or putty based impressions have long been considered the gold standard for capturing dental arches (Suese, 2020; Takeuchi et al., 2018). However, these traditional techniques can pose challenges when used on pediatric patients, as they often cause discomfort, trigger gag reflexes, and induce anxiety during the procedure, potentially leading to negative dental experiences for children (Burzynski et al., 2018; Lipani et al., 2024). This scoping review was conducted in response to the limited number of studies and the varying outcomes and conclusions regarding the accuracy, preference, comfort, and impression taking time of digital intraoral scanners in children.

Digital impression technology using intraoral scanners offers a more comfortable and efficient

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alternative for obtaining accurate dental impressions (Rutkūnas et al., 2020; Suese, 2020). Studies have demonstrated that digital impressions provide comparable, and in some cases superior, accuracy compared to conventional methods, supporting their application in clinical practice (Mangano et al., 2018). This improvement in accuracy contributes significantly to diagnosis and treatment planning, helping to ensure optimal outcomes in pediatric dental care (Yilmaz & Aydin, 2019).

Digital intraoral scanners have gained popularity due to their improved patient acceptance and enhanced comfort (Gökmen et al., 2024; Liczmanski et al., 2020). Research indicates that children and adolescents generally prefer digital intraoral scanners over conventional methods, mainly due to their non-invasive nature, reduced gag reflex, and shorter procedure times (Glisic et al., 2019). The comfort associated with digital intraoral scanning plays an important role in alleviating anxiety during procedures and contributes to a more positive dental experience for young patients. Another notable advantage of digital intraoral scanners is their efficiency in reducing treatment time. Studies show that digital impression techniques require significantly less time than conventional methods, leading to increased clinical productivity and better patient cooperation (Bosoni et al., 2023). This time efficiency not only enhances patient preference but also optimizes dental procedures in pediatric care (Chiu et al., 2020; Khatuja et al., 2023).

Based on these considerations, a literature review is necessary to explore the accuracy, preference, comfort, and time efficiency of digital intraoral scanners in pediatric dentistry. By critically analyzing the latest studies and clinical findings, this review aims to evaluate the benefits and limitations of digital intraoral impression techniques. The use of digital intraoral scanners (DIS) in pediatric dentistry has become increasingly urgent as practitioners and researchers seek to improve the quality of care, enhance patient experience, and streamline clinical workflows. Each of the four key factors accuracy, preference, comfort, and chairside time plays a crucial role in this shift, highlighting the growing necessity of adopting digital scanning technologies in pediatric practices (Parizotto et al., 2023).

Accuracy remains a cornerstone of dental impressions. Inaccurate impressions can lead to faulty treatment plans, poorly fitting restorations, or delayed procedures. Digital intraoral scanners have proven to provide exceptional accuracy, comparable to or even surpassing traditional methods like alginate, which are prone to errors due to material shrinkage or patient movement. Ensuring precision is particularly urgent in pediatric patients, where high quality impressions are crucial for effective treatment planning and appliance fabrication (Mack et al., 2017).

Preference is another critical factor driving the adoption of DIS in children. Pediatric patients often experience anxiety or discomfort with traditional impression materials, leading to a negative dental experience. Digital scanners, by contrast, offer a non invasive, less intimidating alternative that many children find more comfortable. The preference for digital impressions is not limited to children alone; parents and clinicians also favor them for their efficiency and the reduced likelihood of retakes. This preference emphasizes the need to incorporate patient friendly technologies that support both child and parent satisfaction (K. C. Lee & Park, 2020).

Comfort in pediatric dentistry is paramount. Children have smaller oral cavities and are often less able to remain still during lengthy procedures. Traditional impression techniques can trigger gagging or distress, making the procedure challenging for both the patient and the dentist. Digital intraoral scanners eliminate the need for bulky trays and unpleasant materials, providing a more comfortable and stress free experience. This improvement in comfort significantly enhances patient cooperation, which is crucial for obtaining high quality impressions (Rutkunas et al., 2017).

Chairside time is an increasingly valuable resource in modern dental practices. The time spent during appointments is directly linked to patient satisfaction, practice efficiency, and overall workflow. Digital scanners significantly reduce chairside time by streamlining the impression process, eliminating the need for material preparation, waiting for set times, and reducing the frequency of retakes. This efficiency is especially important in pediatric dentistry, where the attention span and cooperation of young patients are limited. Faster procedures help minimize patient anxiety and discomfort while allowing dental practices to serve more patients in a timely manner (Sanda et al., 2021).

The urgency of adopting digital intraoral scanners in pediatric dentistry lies in the compelling advantages they offer across multiple domains. With improvements in accuracy, patient preference, comfort, and chairside time, DIS presents an essential innovation in delivering high quality, child friendly dental care that meets the needs of both patients and practitioners. As the field of pediatric dentistry continues to evolve, integrating digital technologies like DIS will become increasingly critical to achieving optimal clinical outcomes and enhancing the overall patient experience.

Method

The scoping review was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Sugiyono, 2022).

Inclusi Criteria

All clinical studies comparing the use of digital intraoral scanners with conventional dental impression procedures in pediatric subjects under the age of 18 were included. Eligible studies evaluated at least one of the following parameters: accuracy, comfort, preference, or impression time. Only articles published in English between 2014 and 2024 that met the assessment criteria using the CEBM Appraisal Tools were included to provide up to date evidence for clinicians and researchers on the effectiveness of digital intraoral scanners, which are currently regarded as superior and more child friendly alternatives.

Eksclusi Criteria

Studies that did not involve children (under 18 years of age) as research subjects, studies that did not utilize digital intraoral scanners for dental impressions, as well as conference abstracts and editorial articles, were excluded from the review.

Literatur Search Strategy

The literature search was conducted for articles published between 2014 and 2024. Databases used for the search included ScienceDirect, Wiley, PubMed, and Scopus. The initial step involved formulating a PICO framework (Patient, Intervention, Comparison, and Outcome) and identifying relevant MeSH (Medical Subject Headings) terms to guide the development of search keywords. Boolean connectors were then applied to refine the search and identify relevant studies.

Literatur Search Proces

The literature search was conducted in the databases ScienceDirect, PubMed, and Scopus, by formulating the PICO framework as follows:

P : Children
I : Intraoral digital scanner
C : Convensional dental impression/ dental impression
O : Accuracy/ Dimensional Measurement Accuracy, patient preferences, comfort/ Patient Comfort, chairside time/ impression time

Table 1. Literature Search Strategy from 2014 – 2024 (Search conducted in December 2024 - January 2025)

Database	Search strategy	Result
PubMed	(children) AND (intraoral digital scanner) AND (dental impressions)	17
Scopus	(children) AND (intraoral digital scanner) AND (dental impressions)	17
Scient direct	(children) AND (intraoral digital scanner) AND (dental impression materials) AND (accuracy) AND (patient preferences) AND (patient comfort) AND (impression time)	28
Wiley	(children) AND (intraoral digital scanner) AND (dental impression materials) AND (accuracy) AND (patient preferences) AND (patient comfort) AND (impression time)	62
		124

Study Selection

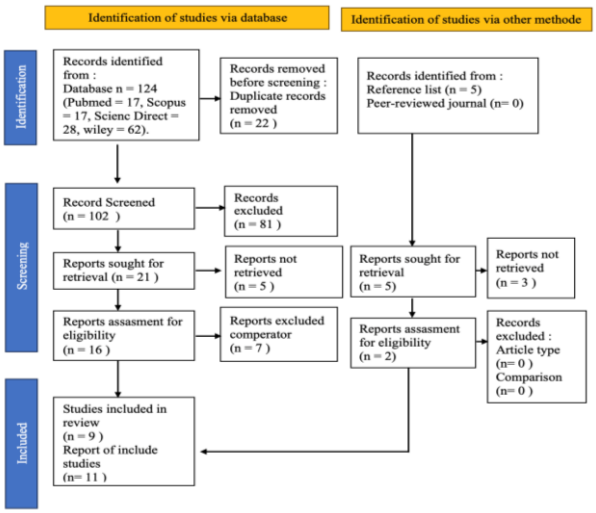

Figure 1. Review process selection with PRISMA extension for scoping review

The studies retrieved were selected using Mendeley Web Importer, which involved checking for duplicate articles to remove any duplicates. The next step was to screen the journals by reading the abstract and methodology sections to ensure they met the inclusion criteria set for the scoping review.

Figure 1, manual and digital search yielded 21 journals related to digital scanners in pediatric samples, of which 16 journals were related to accuracy, preference, comfort, and impression time or one of these, and 11 journals met the inclusion criteria.

Extraction and Data Analysis

Relevant data were extracted using a standard data extraction form created for the purpose of this review, with the following format: author/year, study design, research objective, population characterization, and research results according to the specified variables. The evaluation of the results focused on accuracy,

preference, comfort, and impression time, and how these were related to the use of digital intraoral scanners compared to conventional impression methods. After data extraction, the studies were appraised using the CEBM Appraisal Tools criteria. Data extraction was performed individually by Author 1 and was cross-checked by the affiliated second author. There was high variability in study design, study population, research procedures, and measured outcome parameters, so data analysis in this scoping review was conducted through narrative descriptive analysis. The results of each study were categorized and explained based on the themes focused on in this scoping review. This scoping review was not registered in a public protocol repository such as the Open Science Framework (OSF); however, a protocol outlining the inclusion and exclusion criteria, literature search strategy, and data extraction and analysis methods was prepared in advance to ensure transparency and methodological rigor.

Table 2. Standard Data Extraction Form

Author/ Year	Aim	Study Design	Population Criteria	Accuracy	Preference	Comfort	Chairside time
Lisa Schiefer (2022)	Comparing Stone Model and Digital Model Measurements in Mixed Dentition: Focus on Validity, Reliability, Reproducibility, and Objectivity	Comparative study	Children aged 7–13 years. N = 30 children Mean age = not specified	Digital models are significantly superior in reliability and reproducibility compared to gypsum impression.	Not investigated.	Not investigated	Not investigated
Glisic et al. (2019)	Comparing children's preferences, impression time, dental arch measurement accuracy, and costs between two impression methods (conventional and digital intraoral scanner).	Comparative study	Children aged 9–15 years. N = 59 participants Mean age = 12.7 years	Digital intraoral scanners were significantly more accurate compared to digital models and plaster casts.	Patient experience was significantly better (P < 0.05) with intraoral scanners compared to alginate impressions.	Patient comfort was significantly better (P < 0.05) with intraoral scanners compared to alginate impressions.	Impression time was similar
Mangano et al. (2018)	Comparing patient acceptance, treatment comfort, and stress levels between conventional and digital impression techniques.	Cross-over dengan randomised	Children aged 7 to 16 years. N = 30 children Mean age = 11 years and 4 months.	Not investigated.	100% of patients prefer the digital impression technique.	Digital intraoral scanner is significantly more comfortable compared to conventional impression methods.	Conventional impression methods are significantly faster compared to digital intraoral scanners.
Liczmanski et al. (2020)	Evaluating the accuracy of intraoral scanners in patients with mixed dentition by comparing intraoral scanner results with conventional methods..	Prospective non-randomized comparative clinical trial	Children aged 6 to 12 years. N = 26 children Mean age: Male: 9.3 years, Female: 9.8 years	The intraoral scanner significantly produces more detailed data and fewer errors compared to alginate impressions.	Not investigated.	Not investigated.	Not investigated
Yilmaz & Aydin (2019)	Comparing digital and conventional impression methods in	Comparative Study	Children aged 7–13 years.	Not investigated.	75% of children prefer the	Digital impressions are	Impression time was similar

Author/ Year	Aim	Study Design	Population Criteria	Accuracy	Preference	Comfort	Chairside time
	children across three variables: comfort, patient preference, and impression time.		N = 28 children Mean age = not specified		digital method over the conventional method..	significantly more comfortable compared to conventional ones (P<0.001).	
Burhardt et al. (2016)	Comparing comfort, time, and patient preference between conventional impression techniques and intraoral scanner methods.	Cross Over	Children aged 10–17 years N = 38 children Mean age = 12 years	Not investigated.	Patients prefer the digital intraoral scanner.	Comfort is considered similar.	Conventional impressions are faster compared to digital intraoral scanners.
Bosoni et al. (2023)	Comparing digital and conventional impression techniques in children with variables: patient preference, impression time, and comfort during the procedure.	Crossover Randomized Controlled Trial	Children aged 6–11 years N = 24 children Mean age = 12 years	Not investigated.	18 out of 24 subjects, or 75%, preferred digital impressions.	Comfort was significantly higher for digital impressions (difference of 1.7; 95% CI: 0.5 to 2.8; P = 0.007).	The scanning time was significantly shorter compared to the alginate impression time.
Pahuja et al. (2023)	Comparing the accuracy of intraoral scanners with conventional methods in obtaining dental measurements in mixed dentition patients.	Observasional analitik	22 children aged 5–11 years N = 22 children. Mean age = not specified	The digital intraoral scanner has the same accuracy as conventional impressions.	Not investigated.	Not investigated.	Not investigated
Gökmen et al. (2024)	Comparing the accuracy of palatal ruga in three dimensions (3D) using conventional and digital impression methods.	Study comparative	Children aged 10–17 years N = 22 children Mean age = 13.5 years	There is no significant difference in accuracy between conventional dental impressions and digital intraoral scanners.	Not investigated.	Not investigated.	Not investigated
Serrano-Velasco et al. (2024)	To evaluate the comfort of children with conventional impression methods compared to two intraoral scanners (iTero™ and Primescan™).	A Crossover Randomized Trial	Children aged 10–14 years N = 51 children Mean age = 12.35 years	Not investigated.	Not investigated.	Both digital intraoral scanners are significantly more comfortable compared to conventional impressions.	Not investigated
Serrano-Velasco et al. (2024)	To analyze the accuracy of digital models and 3D	A crossover reliability study	Children aged 10–14 years	Both intraoral scanners show the same	Not investigated.	Not investigated.	Not investigated

Author/ Year	Aim	Study Design	Population Criteria	Accuracy	Preference	Comfort	Chairside time
	gypsum models printed from digital arch impressions using two intraoral scanners (iTero™ and Primescan™).		N = 51 children Mean age = 12.35 years	accuracy as conventional methods.			

Result and Discussion

This scoping review aims to explore and map the scientific literature related to the use of digital intraoral scanners in pediatric populations, focusing on four key variables: accuracy, preference, comfort, and procedure time, as compared to conventional impression techniques. This approach was chosen given the rapid development of digital technology in pediatric dentistry practice and the limited evidence systematically summarizing the experiences and effectiveness of digital intraoral scanners used in children.

Accuracy

The accuracy of digital intraoral scanners in several studies reviewed in this article shows that digital intraoral scanners have excellent accuracy compared to conventional impression methods based on elastomeric materials like alginate (Glisic et al., 2019; Schieffer et al., 2022). these digital systems demonstrate not only high trueness and precision but also offer advantages such as improved patient comfort and faster processing times (Chiu et al., 2020; Khatuja et al., 2023).

However, accuracy can be influenced by several variables, including the type of digital intraoral scanner used, scanner protocols, and the child's level of cooperation during the scanning process. Factors unique to pediatric patients—such as involuntary movements, limited ability to stay still, small oral cavity size, and lower tolerance for prolonged procedures—pose specific challenges. These can affect the completeness and clarity of the digital impressions (Anh et al., 2016; Zarbakhsh et al., 2021).

In addition, several studies have emphasized that while digital intraoral scanners are highly accurate in quadrant or single-tooth scans, their precision may decrease in full arch cases, particularly when patient cooperation is limited (Burhardt et al., 2016; Liczmanski et al., 2020). In such scenarios, even minor movements can disrupt the stitching algorithm of the scanner, resulting in distortions or inaccuracies (Christopoulou et al., 2022).

Nevertheless, the majority of studies indicate that the quality of digital intraoral scanner models is sufficient for clinical use in children. In fact, many authors argue that digital impressions provide clinically acceptable results that meet the demands of pediatric treatments. Therefore, it can be concluded that digital intraoral scanners can reliably replace conventional impression methods, which have long been considered the gold standard in dental practice (Burhardt et al., 2016; Liczmanski et al., 2020). Nevertheless, the majority of studies indicate that the quality of digital intraoral scanner models is sufficient for clinical use in children, and it can be concluded that digital intraoral scanners can replace the reliability of conventional impressions, which have long been the gold standard (Lim et al., 2018).

Digital intraoral scanners (DIS) have transformed modern dentistry by offering a more comfortable and efficient alternative to traditional impression techniques. In pediatric dentistry, the accuracy of these scanners plays a critical role in ensuring successful outcomes in diagnosis, appliance fabrication, and treatment planning. While traditional methods like alginate impressions have long been the standard, digital scanning technology offers a level of precision that is both reproducible and clinically acceptable for use in children (Hayama et al., 2018).

The pediatric population presents unique challenges that can impact the accuracy of digital scans. Children often exhibit limited attention spans, reduced tolerance for long procedures, and involuntary movements during scanning. These behavioral factors, combined with anatomical constraints such as smaller mouths and limited access to posterior regions, can potentially compromise scan quality. Despite these obstacles, studies have shown that modern intraoral scanners are capable of producing detailed and accurate digital impressions in pediatric patients, particularly when proper scanning protocols are followed and the operator is experienced (Goracci et al., 2016).

In clinical practice, the accuracy of digital impressions in children tends to be more reliable for partial arch scans or individual teeth. Full-arch scans, while possible, are more susceptible to errors if the child is uncooperative or moves during the process. Nevertheless, advancements in scanner technology, including faster capture rates and improved software algorithms, have significantly minimized these limitations. As a result, digital scanners are now widely regarded as a viable, and in many cases superior,

alternative to traditional impressions for pediatric dental procedures (Zarone et al., 2020).

Preference

The literature consistently analyzed shows that children prefer the digital intraoral scanner procedure over conventional impressions. This is based on a more comfortable experience, the absence of nausea, and shorter procedure times. Some studies even mention that the use of digital intraoral scanners enhances children's positive perception of dental visits, which can have a long-term impact on oral health behavior (Kumar et al., 2019; Lee et al., 2020).

The preference for digital intraoral scanners (DIS) among pediatric patients has grown significantly, largely due to the comfort and convenience they offer compared to traditional impression methods. Conventional impressions using materials like alginate are often associated with discomfort, gagging, unpleasant taste, and anxiety in children. In contrast, digital scanning is non-invasive, quicker, and more visually engaging, which contributes to a more positive overall experience for young patients. Studies have shown that children generally prefer digital impressions, reporting them as more comfortable and less stressful (Alzahrani et al., 2021).

This preference is not only limited to patients but extends to dental practitioners and parents as well. Clinicians favor digital impressions for their ease of use, reduced chair time, and immediate visualization of results. Additionally, parents often perceive digital technology as more modern and advanced, increasing their trust in the treatment process. The ability to avoid retakes, which are common with traditional methods due to movement or material errors, is another major advantage that supports the preference for digital scanning in pediatric dentistry.

Ultimately, the growing preference for digital intraoral scanners reflects a shift toward child-friendly dental care that prioritizes comfort, efficiency, and accuracy. This trend supports broader adoption of digital technology in pediatric practices and reinforces the importance of integrating patient-centered innovations in dental care.

Comfort

Comfort during the procedure is a subjective but important parameter, especially in the management of children's behavior. Some publications mention that the digital intraoral scanner is significantly more comfortable compared to conventional methods, mainly because it does not involve impression materials that could potentially trigger a gag reflex, feelings of suffocation (claustrophobia), or soft tissue trauma from the impression tray filling the mouth. Comfort is also influenced by the duration of the impression, the child's position during the procedure, and the operator's skill in using the digital intraoral scanner.

Comfort is a key consideration in pediatric dentistry, and digital intraoral scanners (DIS) have been shown to significantly enhance patient comfort compared to conventional impression techniques. Traditional impressions often involve bulky trays filled with impression materials that can trigger a gag reflex, cause discomfort, and provoke anxiety, especially in younger children. In contrast, digital scanners use a small, handheld wand that captures images quickly and without physical pressure, making the process far less invasive.

Children generally tolerate digital scanning much better because it allows them to breathe and speak more freely during the procedure. The absence of messy materials and the shorter duration of the process also contribute to a more pleasant experience. In fact, many children find the scanning process interesting or even enjoyable, especially when they can see a 3D model of their teeth appear on the screen in real-time. This interaction not only improves comfort but can also increase cooperation and reduce fear (Giachetti et al., 2020).

From a clinician's perspective, improved comfort leads to better behavior management, fewer interruptions, and higher quality impressions. As a result, digital intraoral scanners are increasingly favored in pediatric settings for providing a more comfortable, efficient, and child-friendly alternative to traditional impressions (Su & Sun, 2015).

Chairside time

Chairside time is crucial in pediatric dentistry as children tend to have low tolerance for prolonged clinical procedures. The analysis in this scoping review shows varying results between digital intraoral scanners and conventional impression methods. Some studies report that the initial scanning time with digital intraoral scanners is longer, depending on the operator's skill and scanner positioning. However, compared to conventional impressions, digital intraoral scanners are more efficient overall, as they reduce preparation time for impression materials, avoid failures, and eliminate the need for transporting physical models to the laboratory (Motel et al., 2020). The integration of CAD/CAM technology with digital intraoral scanners accelerates the production of restorations. However, a consistent conclusion cannot be drawn yet due to factors like variations in scanner technology, operator skill, and differences in the definition of procedure time across studies. More research with standardized designs and consistent evaluation methods is needed to draw stronger conclusions (Asar et al., 2022).

One of the notable advantages of using digital intraoral scanners (DIS) in pediatric dentistry is the significant reduction in chairside time. Traditional impression techniques often require multiple steps, including tray selection, mixing of impression materials, setting time, and potential retakes due to errors or patient movement. These steps can be time-consuming and challenging, especially with young or uncooperative children. In contrast, digital scanning simplifies the process by capturing a virtual impression in real-time, minimizing procedural steps and reducing overall appointment duration.

Shorter chairside time is particularly beneficial in pediatric settings where children may have limited attention spans or difficulty remaining still for extended periods. By completing impressions more quickly, digital scanners help minimize patient discomfort, reduce anxiety, and improve cooperation. This efficiency not only enhances the patient experience but also increases productivity for the dental practice, allowing clinicians to manage time better and treat more patients effectively.

In many studies, digital impressions have been shown to take significantly less time than conventional methods, especially when accounting for the time saved by avoiding remakes and material-related errors. Overall, the reduction in chairside time with digital intraoral scanners supports their growing use in pediatric dentistry, offering both clinical and operational advantages.

This scoping review highlights limitations in the literature, including small sample sizes, wide age ranges, and lack of standardized evaluation parameters. High variability in the types of digital intraoral scanners used, child age, behavior scores, and comfort/preferences criteria makes it challenging to draw definitive conclusions and conduct a meta-analysis. The findings support the integration of digital intraoral scanners in child care, especially for diagnostic, orthodontic, and restorative procedures. This technology enhances patient comfort and promotes a child-centered, tech-based service model. It also increases clinic efficiency, reduces material waste, connects with digital lab systems, and offers real-time visual education for children. Future research should involve larger populations, narrower age ranges, and standardized time measurement methods.

Digital intraoral scanners demonstrate accuracy comparable to conventional methods and are clinically acceptable, with some studies indicating superior accuracy. Regarding preference, all articles included in the review show that children, especially those aged 6-11, prefer digital intraoral scanners over conventional methods. Comfort levels are also higher with digital intraoral scanners, as they reduce discomfort like gag reflexes and breathing difficulties. However, findings on procedure time are inconsistent and inconclusive due to variations in time definitions, scanner brands, and operator skills, indicating the need for further research with standardized methods and instruments.

Conclusion

Digital intraoral scanners can serve as an alternative printing method for children under 18, as their accuracy is comparable to conventional methods and clinically acceptable. Children prefer digital intraoral scanners and experience greater comfort, but further research is needed to conclusively determine the chairside time required for the procedure.

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The authors declare no conflict of interest.

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