Review Article

COMPARATIVE STUDY BETWEEN CONVENTIONAL MOLDING AND SCANNING IN FIXED PROSTHESIS: a narrative review

ABSTRACT

Introduction: A common question in current dental clinical practice is regarding the choice and use of the best molding method (conventional or digital), especially considering accuracy, patient comfort, and clinical time. Despite conventional moldings being widely accepted and reliable, digital technology offers significant advances in terms of accuracy, which can directly influence the choice of the most appropriate method for each case.
Aims: This study aimed to analyze the current scientific evidence and compare conventional moldings with scanning in fixed prostheses
Methodology: A search was conducted in three databases: PubMed, Scopus, and Web of Science, for scientific articles in English published between 2019 and 2024, which addressed, in fixed prostheses, the comparison between conventional moldings and scanning.
Results: A total of 448 articles were found; after applying the exclusion criteria, 25 articles were selected for this review. Based on the scientific evidence currently available, the conventional technique for moldings in fixed prostheses, using materials such as alginate or silicone, is largely reliable, but may present limitations in terms of accuracy and comfort. With technological advances, digital scanners have become a modern alternative, captured precise digital images of the dental arch and creating 3D models. This method offers advantages such as greater comfort for the patient, elimination of molding errors and the ability to adjust in real time. Integration with CAD/CAM software allows for detailed customization and more efficient production of prostheses
Conclusion: Conventional molding is still used; scanners are emerging as an innovative and effective technology.

Keywords: molding dental, dentistry, fixed prosthesis(es), digital technology

1. INTRODUCTION

Regardless of the molding method, the shape of the prepared teeth and the amount of tooth structure removed are important factors for the mechanical, biological and aesthetic success of fixed prostheses. These characteristics affect the retention and resistance of the supporting tooth and must be adjusted to improve the durability and effectiveness of dental restorations (CARBAJAL MEJÍA, et al., 2019). The conventional molding approach has always been the most effective treatment protocol for obtaining working models in fixed prosthesis. This process uses a wide range of molding materials - such as alginate, polyether or polyvinyl siloxane - together with cast models and the production of a metal restoration covered with porcelain, highlighting the series of procedures necessary to obtain a satisfactory result. Therefore, this treatment concept is, and tends to remain, a gold standard for reproducing an intraoral situation (GARCÍA-GIL et al., 2020).

Although conventional dental moldings have been used in dentistry for over a century, the introduction of intraoral scanners marked a technological advance and a shift into a new era of greater precision, comfort and efficiency. Unlike

traditional techniques that use molding materials and trays, intraoral scanners devices capture highly detailed 3D images of the patient's mouth, creating accurate digital models. With the continuous improvement of technology and the increasing accessibility of equipment, it is expected that this technique will become increasingly widespread, consolidating itself as a standard in current dental practice (AFRASHTEHFAR, et al., 2022). Visiting commercial dental laboratories, it is evident that a portion of the conventional dental moldings presented to the laboratory technician, although used, are considered inadequate, missing adequate copy and containing small deformations due to the removal of the mold, this represents 50% to 90% of the total of conventional moldings made containing incomplete registration (HENKEL, 2007).

At the beginning of their development, the first intraoral scanning systems (e.g. Cerec) had the ability to use the concept of "light triangulation", where the intersection of light beams located points in 3D. However, surfaces that scattered light unevenly affected its accuracy, making it necessary to use an opaque coating of titanium dioxide (powder) to improve results. With technological evolution, current systems, such as the Lava™ Chairside Oral Scanner are based on active wavefront sampling, which uses three sensors to capture images from different angles, generating 3D patches in real time with high precision. The system captures up to 24 million data points per scan, ensuring quality and accuracy due to image overlay and advanced algorithms (SYREK, et al., 2010). As a result, the new technology offers a wide range of benefits, including but not limited to the following: increased precision and adjustability; greater patient comfort; reduced procedure time; better dentist-laboratory communication; and easier archiving. Digital printing represents a considerable advance in dentistry that benefits both professionals and patients. (GJELVOLD, et al., 2016)

For clinical success, the marginal gap must be kept to a minimum. Unsuccessful adaptations to fixed prostheses cause increased plaque retention, favoring changes in the subgingival microflora, which may result in periodontal disease and secondary caries. Large gaps also expose the cement to the oral environment, increasing the risk of microleakage and dissolution of the material. Gaps of less than 120 micrometers are considered clinically acceptable, while for crowns produced by CAD/CAM, the ideal value is less than 90 micrometers. However, conventional moldings are still highly detailed and are often reused and used effectively. Although there are laboratory studies that have already demonstrated the accuracy of marginal and internal adjustment of dental restorations made with conventional and digital techniques, the fact is that clinical studies that truly compare these two lines of action under real-world conditions of use are still scarce. (CHOCHLIDAKIS, et al., 2016). Therefore, this study aimed to analyze the current scientific evidence and compare conventional moldings with scanning in fixed prostheses through a narrative literature review.

2. METHODOLOGY

A search was performed in three databases: PubMed, Scopus and Web of Science, using a search strategy involving the following combination of keywords: (CAD-CAM OR digital impression OR digital technology OR digital fabrication OR intraoral scanner) AND dentistry (fixed prosthesis OR fixed prostheses) AND conventional impression NOT implant. Based on this premise, the following inclusion criteria were adopted: articles published between 2019 and 2024, in English and comparing conventional molding with scanning, and exclusion criteria: incomplete articles.

3. RESULTS AND DISCUSSION

Figure 1: Search Strategy

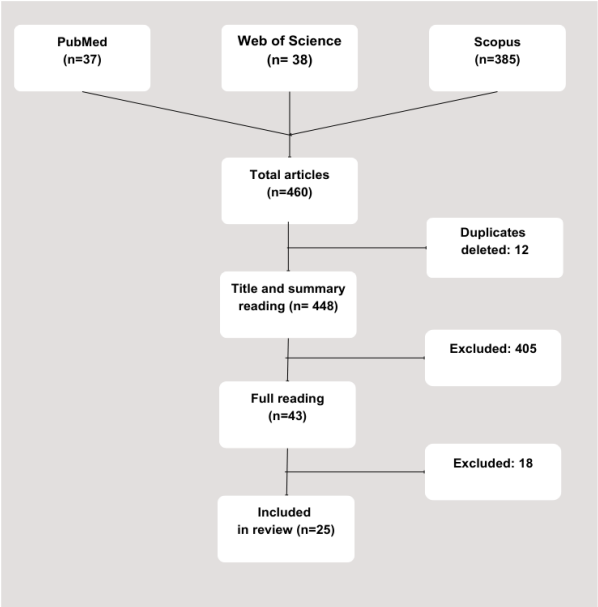

Table 1: Articles selected after applying the inclusion and exclusion criteria in this study

Author	Study Design	Studied Groups	Sample Size	Evaluated Parameters	Methodology	Results
AL MAHAD et al., 2019	In vivo study	Conventional (polyvinyl siloxane), digital (CEREC Omnicam) and hybrid (inEos X5 and inlab CAD SW 15.0) methods of all-ceramic single crowns	n=1	Marginal and internal adaptation (occlusal and axial)	A dental preparation on the upper lateral incisor was made to receive an all-ceramic crown. After conventional molding and scanning (10 each), separated into group/method (4), each mold was scanned, and their respective crowns were manufactured. The internal marginal gaps were then measured and analyzed.	Although occlusal averages were significantly higher than in other locations (marginal and axial). It was shown that the four techniques used to manufacture all-ceramic crowns provided similar precision in the marginal, axial and occlusal positions (non-significant differences).
ARCURI et al., 2019	Systematic Review	*	*	Marginal and internal adaptation	Research strategy was made, using databases and following the inclusion and exclusion criteria defined for study eligibility. PICO question formulation: how (O) is the accuracy of direct scanning (I) compared to indirect scanning (C) in in vivo studies in dentistry (P)? Twenty two articles were included in the study	The direct scanning showed better marginal and internal adjustments when compared to restorations made by conventional molding and subsequent laboratory scanning (indirect)
BENIC et al., 2019	Randomized controlled clinical study	Three digital workflows and one conventional workflow for manufacturing zirconia frameworks for three-units zirconia fixed prostheses.	n=10	Marginal and internal adaptation	For each participant (10), three fixed dental prostheses were digitally fabricated, and one fixed dental prosthesis was conventionally fabricated, in random order. Discrepancies (marginal and internal) were recorded and evaluated by replica techniques and an optical microscope.	Regarding marginal discrepancy, the differences between treatment options were not statistically significant. Regarding internal discrepancy, the digital workflow (iTero) compared to the conventional workflow showed a significant difference in the shoulder region, however in the occlusal region the discrepancy was smaller for the conventional workflow compared to the Lava and Cerec infiniDent flows (P<0.01). iTero had significantly lower values than Lava and Cerec infiniDent (P< 0.01). As for the axial and cusp regions, the values showed no differences between them.
JUNIOR et al., 2019	In vitro study	Ceramic crowns obtained through direct (CEREC Scanner 3D Bluecame) and indirect (polyether together with	n=20	Marginal and vertical adaptation	In a lower right first molar, following a previously established parameter, its surface was scanned. Using this model, 20 titanium trial specimens were milled. After that, they were divided into two	There was no significant difference in vertical marginal misfit between the direct scanning and indirect scanning groups. Showing similarity of results in six of the eight analysis regions studied.

		Cerec Scanner 3D Bluecan) scanning techniques, using the CAD/CAM system.			groups: direct scanning and indirect l scanning. Finally, the vertical marginal misfit was analyzed.	
HASANZADE et al., 2019	Systematic review and meta-analysis	*	*	Marginal and internal adaptation	Search strategy was done using databases for in vivo and in vitro studies and following the inclusion and exclusion criteria defined for study eligibility. PICO Question Formulation: In full coverage restorations (P), does scanning (I) compared to conventional molding (C) provide better results regarding the marginal and internal fit of the restoration (O)? Factors such as heterogeneity between each study were assessed, and a meta-analysis with subgroup analysis was conducted whenever possible. Thirty three articles were included in the study	Regarding marginal adaptation, scanning provided a significantly smaller marginal gap than conventional molding in in vitro studies (P = 0.002). While in the internal adaptation, the internal gap of the scanning was nominally smaller, but the difference was not statistically significant, the molding technique did not significantly influence the result in both studies (in vivo and in vitro). In zirconia, the marginal and internal adaptation showed relevant differences, with a significantly greater difference for the digital method.
KOCAAGAOGLU et al., 2019	In vitro study	Three-unit structures manufactured using scanning (3shape TRIOS-3 group), conventional (Ci group) and powder-free (Cerec Omnicam group) molding techniques.	n=30 human molars and premolars	Marginal adaptation	After preparing the abutment teeth (canines and second premolars) and separating them into three groups of 10 each, laser-synthesized metal structures were designed using conventional molding and scanning. Marginal adaptation was evaluated with a stereomicroscope at ×30 magnification and data were evaluated immediately afterwards. All processes carried out by the same operator.	Significant differences in marginal fit were found between conventional molding groups and those fabricated by scanning. The marginal discrepancy was greater in the conventional molding groups, while in the scanning groups, the difference between the two was not statistically relevant. As for the teeth, there was no statistically significant difference between the marginal mismatches of the canine and premolar teeth within the same groups.
MOUSTAPHA et al., 2019	In vitro study	Fixed dental prostheses with three units based on zirconia printed in three groups: using digitized dental impression techniques (scannable silicone - Honigum Pro light and heavy scan), Trios 3 intraoral scanning (3Shape) and conventional silicone molding.	n=10 zirconia structures	Marginal and internal adaptation	From a master model, zirconia structures were manufactured following the molding techniques studied, 10 for each group. Therefore, an extra-fine grinding strategy was implemented to minimize microfractures. The precision of the structures was evaluated using the replica technique (use of a monocular microscope and digital camera with software to evaluate the target parameters)	The intraoral scanning group showed lower marginal and internal discrepancy compared to the conventional molding group (P = 0.006; P = 0.004) and scannable silicone (P = 0.052; P = 0.045), except at the incisal tip. The intraoral scanning group also presented the highest percentages of margin restorations at the gingival line, while the other two groups presented predominantly subgingival restorations.
SAILER et al., 2019	Randomized Controlled Clinical Trial	Three digital workflows (Lava C.O.S, iTero and Cerec Bluecam) and one conventional workflow (polyether) for manufacturing zirconia frameworks for three-unit fixed posterior dental prostheses supported per tooth.	n= 10 individuals	Clinical time and comfort	For each participant (10), three fixed dental prostheses were digitally fabricated, and one fixed dental prosthesis was conventionally fabricated. For comparison, the sequence of procedures was randomized by computer. The time required for scanning and occlusal registration procedures were evaluated. As well as the comfort and difficulty of molding too.	The conventional workflow showed better total times for full-arch molding including preparation and occlusal registration, compared to the digital flow in the three scanners studied. There was a significant difference in time in two of the three scanners analyzed, the iTero (P = 0.001) and Cerec (P < 0.001). Clinicians preferred conventional molding. As for the participants, they did not have a preference regarding the type of method. The system without the need for spraying was preferred over systems with spraying.
SIM et al., 2019	In vitro study	Three full-arch prosthetic models, one digital obtained using an intraoral scanner (CS3500), another printed in 3D (CS3500 with a 3Dent/ printer), and a model using a conventional method (polyvinyl siloxane)	n= 24	Accuracy and precision	A reference model was made with three teeth prepared for three types of restorations: single crown, 3-unit bridge and inlay. Thus, conventional models, digital models using digital scanning and physical models using a 3D printer were made to be scanned. The datasets were overlaid and evaluated on full-arc accuracy and precision of preparations.	The groups showed significant differences between them in full arc accuracy ($p < 0.001$). Regarding the accuracy of the preparations, the digital and conventional models did not show a significant difference ($p > 0.05$), however the physical model using 3D printing indicated a difference compared to both, presenting a significantly lower value ($p < 0.001$).

AREZOOBAKHSH et al., 2020	In vitro study	3-unit zirconia structures manufactured with CAD-CAM technology using conventional and digital moldings, divided into four groups (conventional polyvinyl siloxane group; intraoral scanner group with TRIOS; Dental Cast-Laboratory/indirect scanner group; intraoral scanner group with CS3600)	n=10 for 4 groups	Marginal and internal adaptation	From a maxillary typodont model with prepared teeth (first premolars and molars) to receive the prosthesis. After receiving the respective moldings from each group, zirconia copings were designed and milled. The marginal, mid-axial, axio-occlusal and mid-occlusal discrepancies were measured using the silicone replica technique with a stereomicroscope at ×50 magnification and then analyzed.	The indirect digital scanning group presented the highest marginal gap values (106 ±45 mm) in relation to the other groups that presented equivalent values between them. Internal gap values were higher in the indirect scanning (248 ±71 mm and 216 ±68 mm) and conventional molding (238 ±92 mm and 227 ±95 mm) groups, while in both direct scanning groups, the overall values were significantly lower. Internal discrepancies in mid-axial position were similar between direct scanning groups, and smaller in conventional and indirect.
GARCÍA-GIL et al., 2020	Case report	A conventional molding treatment with Vinyl polysiloxane and double cord retraction (conventional procedure), and a digital scanning treatment with Trios®, True Definition® and iTero® (IOS).	n=1	Marginal adaptation	The procedure involved removing the old prosthesis and preparing the teeth using the BOPT technique (biological preparation without end line). Conventional molding and scanning were made to create the new prosthesis, using high-precision materials. Both moldings were made under the same conditions to minimize bias. The conventional molding was scanned to create a 3D model, while scans were performed with three different intraoral scanners. The objective was to compare the marginal accuracy of the molding methods used.	Both the conventional molding and scanning techniques presented satisfactory and clinically acceptable results. The intraoral scanners showed differences between them in terms of accuracy, with the Trios being the one that presented the best result. The final restoration was fabricated and cemented. The patient was examined at 3, 6 and 12 months, without any type of biological or mechanical complications.
KUMAR et al., 2020	Systematic review	*	*	Marginal adaptation	Search strategy was done using databases for randomized clinical trials and following the inclusion and exclusion criteria defined for study eligibility. Manual searches were also used. Formulation of the PICO question: Population, intervention, comparison and result. Two independent reviewers assessed eligibility for inclusion, extracted data and assessed the quality of the articles. Three articles were included.	The marginal fit of three units fabricated from direct digital scans was better than those fabricated from indirect digital scans and conventional moldings. The studies included to evaluate the accuracy of marginal adaptation of fixed dental prostheses with digital and conventional scanning proved to be clinically acceptable. Digital scans showed to be more time-efficient than conventional methods.
MORSY et al., 2021	Prospective parallel controlled in vitro study and a blinded randomized controlled crossover clinical trial	Monolithic multilayer zirconia fixed dental prostheses produced by conventional molding (conventional polyether) and scanning (CS3500).	n=12	Marginal and internal adaptation	Twelve patients received conventional polyether moldings and scannings with the CS3500 scanner. Monolithic zirconia fixed prosthesis crowns were fabricated, and internal and marginal fit were evaluated using the replica technique. The veracity and accuracy of the molding methods were analyzed in vitro, comparing virtual models of both groups with a reference scan using 3D software (master model). 3D variations were measured to determine accuracy, and overlays of models from each group were used to assess accuracy.	The Scanning Group showed a significantly better marginal and internal fit than the conventional molding group. The differences in fit were greater at the occlusal level. The veracity and precision averages for conventional and digital techniques were similar, with comparable values in both categories.
AFRASHTEHFAR et al., 2022	Literature review	*	*	Internal fitting accuracy and clinical timing	Search strategy was done using databases for systematic reviews or meta-analyses from 2019 to 2021, excluding primary studies, narrative review and extraoral scanners. Assessment of systematic reviews was carried out by two reviewers supervised by a third	Scanning had accuracy comparable to conventional moldings. All studies reported patient preference for intraoral scanners in the clinical procedure. And the same is reflected in working time, reporting a significant reduction in time with the use of the intraoral scanner.

					review author using the PRISMA reporting checklist and PRISMA-A abstract extension. Eleven articles were included.	
BADIAKY et al., 2022	Systematic review and meta-analysis	*	*	Clinical time, marginal adaptation and patient comfort	Research strategy was done using databases. Supplementary manual searches were performed. All based on the PICO structure: Are digital moldings made with intraoral scanning systems less time consuming than conventional moldings (PICO 1)? Do digital moldings techniques cause significantly less discomfort to patients than conventional molding techniques (PEAK 2)? Are digital moldings more accurate than conventional molding methods in terms of marginal fit (PEAK 3)? The authors assessed the risk of bias at the study level. Sixteen articles were included.	Regarding clinical time, scanning (784 ±252 seconds) presented a significantly similar time compared to conventional moldings (1125 ±159 seconds) ($P > 0.05$). As for patient comfort, they preferred intraoral scanning over conventional molding methods (67.8 ±21.7 to 39.6 ±9.3). In marginal adaptation, it was reported that the average values of marginal adaptation were comparable for both techniques ($P>.0.05$).
IREM GOKCE et al., 2022	In vitro study	Fixed 5-units zirconia dental prosthesis using direct (digital only / 3Shape Trios 3 [3S-IOS] and Cerec Omnicam [C-IOS]) and indirect (hybrid / 3S-IMP, C-IMP, 3S-STN and CSTN) techniques). Resulting in 6 groups.	n= 10 for each group	Marginal and internal adaptation	Preparation on right upper central incisors, canines and second premolars were done by one operator, and the data was categorized into six groups according to the type of scanner used and the type of digital workflow used. After the direct scannings were made, the plaster models were scanned, and the evaluation parameters were then analyzed.	In both the direct workflow (2 flows) and the indirect workflow (4 flows), no statistically significant differences were observed in any region (marginal and internal) between the 6 groups. For each workflow, the highest average gap values were observed in the occlusal area and the corresponding lowest values were seen in the marginal area.
SARAFIDOU et al., 2022	Systematic review	*	*	Marginal and internal fitting accuracy	Research strategy was done using databases. These articles referred to three groups of materials/techniques, including all-ceramic (zirconia; lithium disilicate) and porcelain-fused-to-metal (PFM) restorations. Use of PRISMA as a guideline for the systematic review. The research was guided by the PICO question: Single crowns or tooth-supported fixed partial dentures (P) Digital impression systems (I) Comparison of impression techniques (C) Marginal and/or internal adjustment of the prosthetic restoration (O). Two separate tables with the extracted data were constructed by four of the reviewers. Finally, the data was checked and composed into a table. 35 articles were included.	In the zirconia group, there was a trend towards better marginal and internal adaptation values when the fully digital protocol was followed in short-range restorations. Lithium disilicate, digital scanning and both techniques can lead to restorations with comparable and clinically acceptable marginal adaptation. In single cobalt-chromium and cast gold/palladium-silver alloy crowns, scanning systems allow the manufacture of milled or cast crowns with precision like to conventional molding in marginal and internal adaptation. But the results were not directly comparable due to the heterogeneity of the materials.
BADIAKY et al., 2023	Estudo in vitro	Fixed dental prostheses with five zirconia-based units scanned using conventional (polyvinyl siloxane) and digital (TRIOS 3) techniques	n=18 (9 for the intraoral scanner group and 9 for conventional impressions)	Marginal and internal adaptation	Digital and conventional scans were performed on nine five-element master models with three zirconia-based abutment teeth, resulting in 18 impression results. With the data from the 18 annotated impressions, analyzes were carried out on them to determine the variances in the marginal and internal adjustment of each method (conventional and digital) using the micro-computed tomography replica method.	The group using the digital scanning technique obtained a greater marginal adaptation compared to the group using the conventional molding technique, as it presented a statistically significantly lower average marginal value ($F = 14.56$, $p < 0.05$). Regarding internal adaptation, both groups presented similar results, without statistically significant differences ($F = 1.56$, $p > 0.05$).

ÇIN et al., 2023	In vitro study	To compare monolithic zirconia crowns manufactured using a digital workflow (intraoral scanner/CEREC AC Omnicam) with those using a semi-digital workflow, which combined conventional molding (vinylpolysiloxane), cast molds and molds scanning (inEos X5).	n=20 (10 for the intraoral scanner group and 10 for the cast molds scanning group)	Marginal and internal adaptation	A lower right molar was prepared for a ceramic crown and scanned with an intraoral scanner, while cast molds were made from conventional moldings and scanned. Identical virtual models were created for both methods, and monolithic zirconia crowns were fabricated. The marginal and internal fit of the crowns was assessed using the silicone replica technique, with measurements taken at 13 specific points using a stereoscopic microscope zooming from ×6.5 to ×50.	The digital workflow group (intraoral scanner) presented lower average marginal and internal gap values compared to the semi-digital workflow, indicating better adaptation in these analyzed regions. However, both workflows provided acceptable marginal and internal fit for CAD-CAM monolithic zirconia molar crowns (with average gaps ranging between 29 and 75 µm).
KALANTARI et al. 2023	In vivo study	Three-unit monolithic zirconia fixed dental prostheses using conventional and scannable polyvinyl siloxane molding materials (3Shape D810).	n=10 patients	Marginal adaptation	All patients were selected to replace their lateral teeth with a three-unit monolithic zirconia bridge. Moldings were made using two different polyvinyl siloxane techniques, one scannable and the other conventional. Marginal discrepancy was measured on replicates cut in the buccolingual and mesiodistal directions, and data were analyzed with an independent t test.	The marginal discrepancy of the central pillar teeth and canines in the conventional moldings' method in the four regions mid-buccal, mid-lingual, mid-mesial and mid-distal was greater than that in the digital method. However, it was not significantly different. Therefore, conventional and scannable polyvinylsiloxane molding materials did not significantly affect the marginal fit accuracy.
LIANG et al., 2023	In vitro study	Fixed three-unit ceramic dental prostheses manufactured using conventional (polyether) and digital techniques with free software (CEREC Omnicam and CEREC 4.5.2).	n=10 vitroceramic dental prosthesis	Marginal adaptation	A digital workflow and conventional molding were used to manufacture 10 vitroceramic dental prostheses using the lost wax hot pressing technique. Three-dimensional data from the abutments and prostheses were captured with a dental scanner and aligned using registration technology. The marginal discrepancy was measured by the distance between the abutment and crown margins.	In marginal adaptation, the absolute marginal discrepancy for fixed three-unit ceramic prostheses, made using the conventional method (106.69±6.46µm) compared to the digital method (102.55±6.96µm), did not show major differences not statistically significant.
MORSY et al., 2023	Systematic review and meta-analysis	*	*	Marginal and internal adaptation	The study involved searches in databases and additional manual searches. For the meta-analysis, standard mean differences and 95% confidence intervals were calculated. The research was guided by the PICO question about the comparability of marginal and internal adaptation between scans with intraoral scanners and conventional moldings of fixed zirconia prostheses, regardless of the scanner or material. A subgroup analysis was also performed to evaluate the impact of variables such as type of restoration, number of units, type of intraoral scanner. Nine articles were included.	Scanning demonstrated a significantly better marginal adaptation than conventional, especially in fixed prostheses of 3 units compared to 4 units and also when using polyvinyl siloxane instead of polyether. Additionally, a 50 mm cement spacer improved the marginal fit in the digital group, with the TRIOS scanner performing best. The type of molding material and the number of units significantly influenced the marginal fit.
SAEED et al., 2023	Systematic review and meta-analysis	*	*	Marginal and internal adaptation	A search was carried out in databases to identify relevant studies, evaluating the risk of bias in in vitro experiments with the Modified Methodological Index. PICO question wording: Regarding tooth-supported fixed partial dentures (P), do scanning techniques (I) compared to fabrications using conventional molding techniques (C) improve the marginal and internal fit (O)? The meta-analysis compared marginal and internal fit between digital and conventional techniques, calculating standard mean differences and confidence	The results showed that, for the marginal fit, there was no significant difference (P = 0.06), while for the internal fit, there was a significant difference (P = 0.02). Subgroup analysis indicated varying results for scanning methods and gap length, with some significant differences noted. The thickness of the cement also showed significant differences for marginal and internal fits.

					intervals. Additional analyzes evaluated the influence of factors such as scanning method, cement thickness, and gap length on the fit of fixed prostheses. Seven articles included in this systematic review, and only 5 were selected for quantitative data analysis.	
BESSADET et al., 2024	Systematic review	*	*	Clinical time and cost	Two researchers carried out a preliminary search using keywords, articles were selected, and then a spreadsheet was created for data management. They applied the CONSORT GRADE approach to evaluate the quality of evidence in the various studies, independently evaluating each selected study according to the target parameters. Eight articles were included.	In all studies, it was shown that scanning has a considerable advantage over conventional moldings when comparing clinical time, both in single crown fabrications and in 3-unit fixed partial prosthesis fabrications (clinically and laboratory). Regarding the comparison of costs between them for fixed prostheses, no article presented analyzes on this.
MAHATO et al., 2024	Systematic review	*	*	Clinical time, patient and operator satisfaction, clinical outcomes, costs, accuracy and adjustment	PICO question formulation to identify and structure the fundamental components of the study: How does the complete digital workflow, which includes intraoral optical scanning, virtual design, and monolithic restoration, compare to conventional workflows (such as conventional molding, casting, lost wax, structure and coating) in terms of overall feasibility, success, accuracy, cost-effectiveness, aesthetics and patient-centric factors? Database searches were carried out and articles were selected by two independent reviewers in a three-step selection process. Twenty two articles were included.	Digital scanning processes compared to the conventional molding method showed better results in clinical and laboratory time, patient and operator satisfaction. Regarding costs, the results were inconclusive (varied values), but it was an excellent cost-benefit as it promoted time optimization and good precision. As for precision and adjustment, it was similar with both workflows, although digital presents potential room for improvement to take advantage of clinical results.

Conventional Molding

In a clinical context of fixed prosthesis, a patient undergoing this type of procedure, aiming at its success, it becomes essential to establish factors such as: biocompatibility, aesthetic, fracture resistance and adaptation (ARCURI, et al., 2019). The latter, when neglected, promotes dental maladjustments, causing excessive accumulation of plaque, microleakage, cement breakage and ceramic fracture, thus increasing the risk of secondary caries, periodontal disease, various pathologies, bone resorption and pulp inflammation, preventing the possibility of restoration longevity (ARCURI, et al., 2019 and JUNIOR, et al., 2019).

For over a century, in dentistry, the conventional method of dental molding has been the application of molding material in a tray, which is inserted intraorally until it sets, creating a negative copy of the desired structures (AFRASHTEHFAR, et al., 2022). Suitable molding materials are essential for the correct molding of the tooth surface, copying its entire anatomy precisely and avoiding irregularities or distortions caused by the copying process. The creation of moldings is an indispensable step in fixed prosthetics. The conventional method leads to contraction of soft tissues, following the impression formed by elastomeric materials with different viscosity rates (SARAFIDOU, et al., 2022). Both polyether and polyvinyl siloxane are the “gold standard” materials for this procedure, both materials are used in in vivo printing to make plaster models and fabricate a porcelain or ceramic fused to metal restoration, providing dimensional stability and high precision (GARCIA GIL, et al., 2020).

Although with the emergence of software and scanners in recent decades, conventional moldings have continued to be widely used, being adopted as the procedure of choice in dental clinics (BADIAKY, et al., 2023). Much of this is justified by the fact that it is a more accessible method, both for the patient and the clinician, in addition to its easy manipulation and handling (BESSADET, et al., 2024). Conventional techniques, on the other hand, when poorly handled, such as: inadequate selection of the tray and incorrect preparation of the material, trigger various problems ranging from polymerization problems, the existence of voids or debris in important areas and exposure of the less precise dense material, to deformations of the impression before pouring and dimensional variations of the plaster model. In addition to these disadvantages, others now associated with clinical factors are found in the literature, such as: nausea, unsatisfactory taste and discomfort. Thus, failure in the molding process causes the need to repeat steps, in which the time consumption that was previously considered high and one of the main disadvantages in this process, becomes even greater (AREZOOBAKHSH, et al., 2020; GARCIA GIL, et al., 2020; SAEED, et al., 2023). Conventional molding is widely accepted; the materials and methods are routinely applied; and the costs are relatively low. On the other hand, digitalization is linked to significantly higher initial costs and a long learning curve (SAILER, et al., 2019).

Scanning

In recent years, dentistry has undergone significant advances in all its aspects, and this is justified by the advancement in technologies such as software (computer-aided design and computer-aided manufacturing/CAD-CAM) and intraoral scanners, providing a faster workflow by skipping steps existing in the conventional method (ARCURI, et al., 2019). The CAD/CAM system is divided into two processes: the CAD procedure for collecting data by scanning with scanners and designing restorations using precise software, and the CAM procedure for manufacturing restorations after data processing (SAEED, et al., 2023). The fact is that, currently, the accuracy of scanners has been compared to conventional impressions, presenting statistically non-significant differences when analyzed by professionals. (SAILER, I. et al., 2019).

In 1987, the first intraoral scanner available on the market was made, the CEREC1 System (Dentsply Sirona), which worked based on the principle of light triangulation, requiring the use of powder on the tooth surface beforehand to improve the quality of the impression (ARCURI, et al., 2019; AL HAMAD, et al., 2019). Contemporaneously, scanning techniques using intraoral scanners that were previously used for basic procedures have developed considerably and are now reliable, reproducible and more comfortable for the patient, and can be used to design inlays, onlays, single crowns, three-element prostheses and, more recently, full arch (BADIAKY, et al., 2023). Since then, several scanning systems have been developed, with emphasis on: CEREC (Dentsply Sirona, York, Pennsylvania, USA), LavaTM C.O.S (3M, Maplewood, Minnesota, USA), iTero (Straumann, Basel, Switzerland), E4D (Planmeca, Helsinki, Finland) and TRIOS (3Shape, Copenhagen, Denmark), which are some of the most widely used scanning systems on the current market, and which are still based on the use of several three-dimensional images to obtain a three-dimensional object (ARCURI, et al., 2019; AFRASTEHFAR, et al., 2022). These advances in technology have resulted in a new generation of scanners that, in addition to presenting excellent precision, are more practical for professionals, as they no longer require the use of powder. As a consequence, there is a growing trend towards the adoption of digital techniques (HASANZADE, et al., 2019).

Unlike conventional moldings, the digital workflow eliminates tray selection, material setup and disinfection, packaging and transportation, and other laboratory procedures including casting, assembly, sectioning, and restoration fabrication

(AL HAMAD, K. *et al*., 2019). Furthermore, scanning was able to solve problems for both the patient and the dentist, such as: nausea, unsatisfactory taste, discomfort and time consumption (GARCIA GIL, et al., 2020). Direct and accelerated communication between dental surgeons and dental prosthetic technicians, in addition to data storage, have become more common in daily clinical practice, enabling errors or limitations to be quickly detected together with software systems, offering a better treatment plan and results satisfactory (SAEED, et al., 2023; SARAFIDOU, et al., 2022).

The scanning method, on the other hand, has adverse factors that can negatively influence the scanning result. These disadvantages range from the movement of the patient and operator, the presence of saliva and/or blood, obstructions caused by the tongue and/or cheek, to the limited space for the intraoral scanner and the reflection of light on intraoral structures. Likewise, the mathematical quality of the files generated by the scanner is another crucial factor, being influenced by the accuracy and resolution of the device (GARCIA GIL, et al., 2020). The scanning is associated with high acquisition costs and a long learning curve, which justifies the limited presence of this equipment in daily clinical practice (SAILER, et al., 2019). In practice, it is difficult to achieve a perfect adaptation, for this reason, both techniques (digital and conventional) are recommended for oral molding. It is up to the dentist and the patient to decide what is best in terms of comfort, practicality and experience for both (KOCAAGAOGLU, et al., 2019).

Comparing the two techniques

This narrative review included 25 studies (in vivo, in vitro, clinical and systematic reviews) that compared conventional moldings with digital scanning techniques in relation to marginal and internal adaptation, clinical time and patient comfort (BADIAKY, et al., 2022).

In the case of marginal and internal adaptation, the findings were divergent. Afrashtehfar et al., (2022) reported that intraoral digital scanning has comparable accuracy to conventional moldings in simulated clinical scenarios, especially for cases of definitive single-unit fixed dental reconstructions up to three units. This fact was also addressed in studies by Liang et al., (2023), Kalantari et al., (2023) and Badiaky et al., (2022). Similar results were also found in the studies by Al Hamad et al., (2019) and Junior et al., (2019), in which they differed by the study group evaluated, when they compared direct scanning techniques (CEREC Omnicam and CEREC Scanner 3D Bluecame, respectively) with indirect scanning techniques (polyvinyl siloxane) with inEos, from this, perform an molding scanning to send data to the CAD/CAM system, however this is susceptible to failures or distortions due to the increase in steps to be carried out (IREM GOKCE, et al., 2022).

However, other studies show that three-unit fixed prostheses made using intraoral scanning techniques present better marginal and internal adaptation results compared to conventional methods. Specifically, Arezoobakhsh et al., (2020) and Kumar et al., (2020), observed a significant reduction in marginal discrepancies (including analyzing indirect scanning as well), while Moustapha et al., (2019) and Arezoobakhsh et al., (2020), who, in addition to this result, reported a more precise internal adjustment (axial and occlusal walls, respectively), providing greater comfort and durability for patients. Thus, three-units fixed prosthesis showed significantly better accuracy than four- or five-units fixed prosthesis (extensive dental fixed prosthesis), due to the greater chance of errors when stitching together multiple images during intraoral scanning on longer edentulous ridges. Furthermore, the lack of reference points to align these images and the displacement of the mucosa during soft tissue scanning can result in errors (MORSY, et al., 2021). However, in recent

studies, such as Sarafidou et al., (2022) and Morsy et al., (2023), fully digital workflows end up being the protocol of choice for four-units zirconia-based restorations, as well as Irem Gokce et al., (2022) Badiaky et al., (2023) and Saeed et al., (2023) argued that prostheses fixed by intraoral scanning of five units present better marginal and internal adaptation results, and that differences were not statistically significant when compared with conventional molding methods. This discrepancy is likely due to the marginal and internal gap values observed in experimental results reported in literature published in previous years (SAEED, et al., 2023).

Therefore, these studies highlight the effectiveness and precision of digital techniques compared to conventional ones. However, the results of different studies need to be carefully compared due to external variations, whether in tooth preparation, the type of scanner and CAD-CAM system used, the type of material used for the mold (e.g. polyether, polyvinyl siloxane) or restoration (ceramic or porcelain), in the design parameters of the restoration, in the sample evaluations before or after adjustment and in the gap measurement method used (marginal and internal) (HASANZADE, et al., 2019; AREZOOBAKHSH, et al ., 2020). Like Benic et al., (2019), who in their study determined that 3-units posterior fixed dental prostheses, digitally manufactured zirconia structures presented similar or better marginal adjustment than conventionally manufactured metallic structures, while, in the regions occlusally, conventionally fabricated metal frameworks achieved a more favorable internal fit than CAD-CAM zirconia frameworks. Hasanzade et al., (2019), concluded that in the production of a single crown, the scanning technique showed better marginal adaptation than conventional molding, and adverse factors such as the thickness of the spacer, the type of material used (zirconia, lithium disilicate and cobalt-chromium) also presented the same result, but with the addition that the differences in marginal and internal gap were not statistically significant for the study.

Although articles in this work presented clinically acceptable results for margin (<120 µm), and for internal adaptation (between 100 and 300 µm) (ÇIN, et al., 2023; AREZOOBAKHSH, et al., 2020), it is worth noting that internal variations are also essential to be evaluated when determining the type of molding technique, since components such as saliva and blood can directly interfere with the capture of increasingly precise impressions, whether mainly through the digital method, either conventionally (MOUSTAPHA, et al., 2019). Therefore, limitations of this cited study become evident, since the steps applied to evaluate the marginal and internal adaptation parameters varied between studies, which justifies the diversity in results. Besides, the professional's learning curve and experience seem to significantly influence the time required for printing (BADIAKY, et al., 2022). Thus, mastery of scanning techniques, familiarity with the equipment used and the ability to handle the materials used are crucial. Hence, the standardization of assessment methods and continuous training are essential to obtain more consistent and reliable results.

Clinical time and patient comfort were evaluated in five studies, as described by Afrashtehfar et al., (2022), the results, although comparable between both methods, tend to indicate a greater reduction in time with the use of intraoral scanners. Badiaky et al., (2022), Bessadet et al., (2024), and Mahato et al., (2024), digital scanning techniques took significantly less chair time compared to conventional molding, prevailing both in single crown fabrications, as well as in 3-unit fixed partial prosthesis fabrications (clinically and laboratory-based). Even so, authors such as Sailer et al., (2019), found the opposite, that the conventional workflow presented better total times for full arch molding (better capture of the molar region that suffered distortions in the scanners) including preparation and occlusal registration, procedures considered significantly more difficult by professionals (Lava P = 0.002, iTero P = 0.010, Cerec P <.001, compared to

conventional molding). This fact can be justified by the powder spraying, although many scanners still require a layer of powder on the tooth surface to continue the intraoral scanning procedure, when making movements in the scanner, accuracy is affected during the scanning process, making it evident that its use directly influences not only clinical time, but also patient comfort (BADIAKY, et al., 2022). This is justified because today scanners such as Itero, Cerec Omnicom and TRIOS, which do not use powder, present advantages in terms of clinical time and patient comfort compared to conventional moldings, indicating their preference (BADIAKY et al., 2022; SAILER et al., 2019). Mahato et al., 2024, reaffirmed this statement, indicating that the preference for scanners in relation to conventional techniques went far beyond just the patient, but also the operator, in whom, with knowledge and adequate management of the equipment, it was able to speed up and skip steps that previously existed in the conventional method, in addition to facilitating data storage and communication with the laboratory.

Scanning appears to be a very intriguing technique as it offers several advantages over the conventional method. In addition to providing excellent precision in captured details, it significantly reduces working time, eliminates the need for physical materials and reduces patient discomfort. Digitization also facilitates data analysis and storage, allowing for faster and more accurate adjustments. However, differences between scanners have been found in terms of accuracy and are justified by several reasons, such as the type and technology of the scanner, type of restorative material, the experience of the operator or the presence of saliva and/or blood in the capture process. Even though conventional molding is still considered an excellent option in daily clinical practice, it is a fact that this new technology has not only come to improve the efficiency of processes, but also to increase the quality of results. Therefore, it is essential that more clinical and long-term studies are needed to standardize the analysis and establish the ideal use of scanning in different clinical scenarios, making it essential that oral health professionals are up to date on new technologies and develop skills to use these devices effectively.

4. CONCLUSIONS

Based on the articles included in this study, the scanning technique on fixed prostheses proved to be an excellent option for professionals when compared to conventional molding methods. In relation to marginal and internal adaptation, it presented similar or even better results, ranging from single fixed prostheses to prostheses with 3 to 5 units. Regarding the reduction in clinical time, its prevalence was unanimous, showing significantly better results compared to conventional molding. And regarding patient comfort, current scanning procedures indicate more comfort compared to the steps performed in the conventional technique. It is undeniable that this technology has contributed significantly to dentistry. It is up to the professional to choose the technique that best adapts to their knowledge and that provides comfort for both.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)
Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT AND ETHICAL APPROVAL
It is not applicable.

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