

## Fixed partial prosthesis impression: conventional versus digital method

## Moldagem em prótese parcial fixa: método convencional versus digital

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### ABSTRACT

The systematic review of the literature aimed to compare the conventional and digital impression methods for making fixed partial dentures using the current literature and to verify the applicability of the methods in the clinical routine. A search was carried out in the PubMed database using the keywords: Denture, Partial, Fixed and Dental Impression Technique from 2017 to 2022, of studies published in full, in English and free of charge. 520 articles were obtained from PubMed, 501 of which were from 2017 to 2022. After reading the titles and abstracts, 12 articles were excluded. In the end, 6 articles were selected, and 6 articles were later added by cross-reference, totaling 12 articles. Both impressions are good methods to perform impressions in fixed partial dentures, each method having its applications,

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advantages and disadvantages, and it is up to the dental surgeon to select the impression method to be used, considering the time spent for the impression, the learning curve, the personal, practical and social background, in addition to the cost used to acquire materials, clinical hours and laboratory work in the short and long term.

**Indexing terms:** Dental impression technique. Dentistry. Fixed partial denture.

## RESUMO

A revisão sistemática da literatura teve como objetivo comparar os métodos de moldagem convencional e digital para confecção de próteses parciais fixas com a literatura atual e verificar a aplicabilidade dos métodos na rotina clínica. Foi realizada uma busca na base de dados PubMed utilizando as palavras-chave: Denture, Partial, Fixed e Dental Impression Technique de 2017 a 2022, de estudos publicados na íntegra, em inglês e gratuitamente. Foram obtidos 520 artigos do PubMed, sendo 501 de 2017 a 2022. Após a leitura dos títulos e resumos, 12 artigos foram excluídos. Ao final, foram selecionados 6 artigos, sendo posteriormente adicionados 6 artigos por referência cruzada, totalizando 12 artigos. Ambas as moldagens são bons métodos para realizar moldagens em próteses parciais fixas, cada método tendo suas aplicações, vantagens e desvantagens, cabendo ao cirurgião-dentista selecionar o método de moldagem a ser utilizado, considerando o tempo gasto para a moldagem, a curva de aprendizado, o background pessoal, prático e social, além do custo de aquisição de materiais, horas clínicas e trabalhos laboratoriais a curto e longo prazo.

**Termos de indexação:** Técnica de moldagem odontológica. Odontologia. Prótese parcial fixa.

## INTRODUCTION

Conventional impression is based on the use of a tray that will take the impression material to the mouth and support it. Digital impression is based on the use of an intraoral scanner (direct scanning) that detects the oral structures and captures them as 3D data, converted into polygon data, and form the image or an extraoral scanner (indirect scanning), where the patterns are scanned [1]. Its success depends on the technique and experience of the professional using the scanner and the conditions of the structure to be scanned, such as the absence of blood, saliva or tissues [1-4].

## METHODS

The present study is part of a systematic literature review. The literature search was performed in March 2022 using the MEDLINE (PubMed) database.

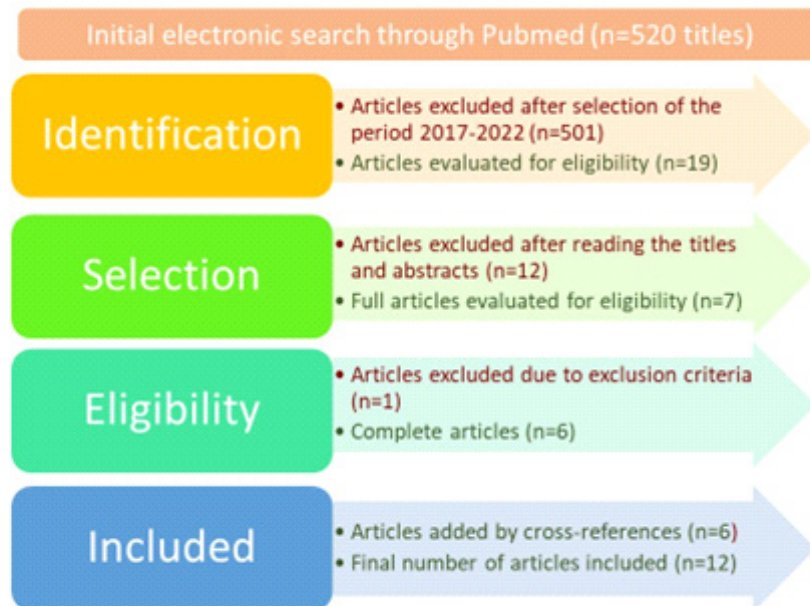
To locate the articles, keywords registered in the Mesh were used. The words used were: Denture, Partial, Fixed and Dental Impression Technique. As a search strategy, the combination of keywords and Boolean operators was: (“Dental Impression Technique”[Mesh]) AND “Denture, Partial, Fixed”[Mesh].

In order to obtain current results, the search for articles was limited to scientific works published between 2017 and 2022, freely available in English.

The inclusion criteria were: articles whose objective was to evaluate impressions in fixed partial dentures both by the conventional method and by the digital method (intraoral scanning) (assessing the precision, technique, advantages and disadvantages, etc); clinical studies; in vitro; case reports and literature

reviews. Regarding the exclusion criteria: articles with deficient methodological description, monographs, theses, dissertations, opinion articles, letters to the editor, articles not available in full or free of charge and prior to the year 2017.

In the end, 520 articles were obtained from PubMed, 19 from 2017 to 2022. After reading the titles and abstracts, 13 articles were excluded. In the end, 6 articles were selected, and 6 articles were later added by cross-reference, totaling 12 articles (figure 1).



**Figure 1.** Flowchart of the methodology used for the selection of articles.

Kim and Kim [5] prepared the lower right premolars and molars of an acrylic model to receive 4-element fixed partial dentures. Three master models were made. The NP model (without pontic), the 1P model (1 pontic) and the 2P model (2 pontics). The models were digitized directly and indirectly. Fixed partial dentures of 4-element using zirconia were produced and distributed among the groups and subdivided between direct and indirect scanning with ten samples. The prostheses were also evaluated for the existing or non-existent pontics and the marginal, axial and occlusal widths of the prostheses were evaluated. After, the values were statistically analyzed in order to assess the amount of gap present.

Morsy et al. [6] selected 12 patients who underwent a conventional polyether impression (control group) and a digital impression with CS3500 with twelve samples. Multilayer zirconia monolithic fixed partial dentures were produced. The fit (both internal and marginal) was evaluated through the method of replica. The veracity and accuracy of the molding methods were evaluated in vitro and a master model was the reference for scanning. The master model was molded by conventional and digital impressions, resulting in five samples each, and the virtual models were superimposed (5 overlaps) on the reference scan using 3D processing software and the 3D divergences were calculated to get the real value. The accuracy of the models was overlapped (ten overlaps) and the value of the divergence was calculated and analyzed by Mann-Whitney U test.

Sailer et al. [7] selected 10 patients to fabricate four fixed partial denture structures for the same patient's tooth in an aleatory order. Digital workflows were used to fabricate three structures of zirconia using the systems Lava, iTero and Cerec InfiniDent. The conventional workflow was performed with a molding using polyether followed by hand waxing, technique of lost wax and frame of casting of metal. The variances of the structures and the abutment teeth were recorded using the method of replica using polyvinylsiloxane evaluating marginal and internal discrepancy of 4 different regions and were evaluated through a light microscope.

Moustapha et al. [8] used a model that included a central incisor and canine without a lateral incisor, both in upper arcade. Thirty zirconia frameworks were fabricated using 3 impression techniques (ten samples each), conventional impression using silicone, digital impression and Trios 3 intraoral scanner (3Shape).

Sailer et al. [7] selected 10 patients who required a 3-element fixed partial denture supported by a posterior tooth. Three scans and workflows (Lava, iTero and Cerec) were compared with the impression method using polyether and conventional workflow. The impression procedures were randomized for the patients. The period required for impression was evaluated, and patients and the dentist perceptions of impression comfort and difficulty were evaluated by visual analog scales.

Sedky and Abd-Elwahab Radi [9] selected ten patients between the ages 49 to 77 who needed fixed partial dentures with 3 posterior elements. The abutment teeth were 12 teeth in the maxilla and 8 in the mandible. Only abutments without extensive pretreatment were eligible. Three scans' systems (Lava, iTero, and Cerec) and conventional polyether impression were performed on each participant by only one dentist. Was used impressions with alginate to molding the opposite arch. The techniques used were randomly selected. Three experienced dentists realized the treatment following the guidelines for the preparation of abutments receiving ceramic fixed partial dentures produced by CAD/CAM. After removing the provisional prosthesis and application of the double retractor wire, the impressions procedure was initiated. The scans were according to the manufacturer's guidelines. The visual analogue scale was used to measure the perception of dentists and patients. Patients were questioned about procedure' comfort and dentists about difficulty and comfort.

Almeida e Silva et al. [10] uses a titanium master model. Twelve conventional polyether impressions of the master model and twelve digital impressions were made using the Lava (TM) system. The method of replica was used and was used the Mann-Whitney U statistical test to find out differences between groups, about fit (marginal and internal), as well as comparisons between groups.

Giachetti et al. [11] performed an electronic systematic search of PubMed, Web of Science, Embase, and Cochrane Library databases searching terms like fingerprint, intraoral fingerprint, intraoral scanner, intraoral digital scanner, conventional print, analog print, and precision. The results show studies evaluating the veracity and precision of digital impressions when is compared to conventional high-precision impressions in vivo.

Su and Sum [12] designed a pattern model containing a superior left canine and second premolar without a first premolar and it was scanned and exported as an experimental group (digital group). Ten models were made from the first model as a control group (conventional group). CAD-CAM fixed partial denture zirconia frameworks were made. These structures were seated in the pattern model and analyzed for fit (marginal and internal). The structures were divided into four sections per tooth, obtaining eight sections per structure, and was noted by light microscopy at x50 magnification.

Sailer et al. [13] selected 10 patients and fabricated a monolithic crown for each. Four CAD-CAM digital streams were evaluated (Lava COS, Cares, Cerec Connect and Cerec Connect with laboratory-side CAM). Conventional technique made a crown from the lost wax technique. The time for making the models and crowns was registered and later, the crowns were clinically evaluated and the times were registered.

Sakornwimon and Leevailoj [14] selected 16 patients with needed a crown in a molar tooth. Impressions, digital and with polyvinylsiloxane, were made. Patients answered a questionnaire with a visual analogue scale talking about their feelings about the impressions with the topics: time involved, taste/smell, occlusal registration, tray/scanner size, gag reflex, and general preference. Crowns were made from both impressions using CAD-CAM. The crowns were evaluated and registered the marginal discrepancy.

Nedelcu et al. [15] used a model with crown preparation (supra and subgingival cervical termination) scanned as reference by an industrial scanner (ATOS) and with 7 intraoral scanners: 3M, CS3500 and CS3600, DWIO, Omnicam, Planscan and Trios. A conventional impression was made and cast, and scanned with a laboratory scanner. Precision was analyzed and was made a descriptive analysis to register.

## RESULTS

Kim and Kim [5] concluded that the length of the toothless area influenced the dimension of the marginal and internal gap, using direct scanning, which resulted in smaller gap widths in the areas that were measured when compared to indirect scanning. Nonetheless, the differences were smaller than 12  $\mu\text{m}$ , not significant in the clinical routine, and the presence of pontics had significance on the marginal and axial clefts.

Morsy et al. [6] found no significance for conventional and digital impressions in the precision of the 3D datasets, and the techniques have as a result fixed partial dentures clinically acceptable. Nevertheless, fixed partial dentures produced by digital impression showed better marginal internal fit.

Sailer et al. [7] evaluating the study, were able to conclude that in relation to the adjustment of the framework in the shoulder area, the structure of 3-element obtained digitally showed a same or better fit compared to those obtained conventionally with metal structures. In the occlusal areas, the structures obtained conventionally reached a better fit than CAD-CAM zirconia structures.

Moustapha et al. [8] with the results obtained, concluded that the best fit was obtained by intraoral scanner, other than for the incisal tip and the impressions showed a higher percentage of underextended restorations.

Sailer et al. [7] concluded from the results obtained that for full-arch impressions, impressions using a conventional method used less time and were preferred by dentists and patients in comparison with digital impressions.

Sedky and Abd-Elwahab Radi [9] in this study it was possible to conclude that conventional impression of the full arch takes less time and is preferred by dentists and patients in comparison of digital scanning.

Almeida e Silva et al. [10] concluded that structures obtained by digital and conventional impressions presented marginal fit acceptable in clinical routine. Structures manufactured from digital molding presented better internal fit in comparison with from conventional molding.

Giachetti et al. [11] based on the results found, were able to conclude that conventional impressions made with high-precision impression materials were more accurate than digital impressions. Meantime,

further investigations evaluating the precision of fingerprints in a wider range of clinical situations are advised.

Su and Sum [12] with the results obtained, were able to conclude that the 3-element zirconia obtained by CAD-CAM manufactured from digital and conventional intraoral impressions showed appropriate fit in a clinical routine fit and the fit of the structures from the digital method was better in comparison with conventional impressions.

Sailer et al. [13] in conclusion, found that regardless of the CAD-CAM system, the time spent for a digital workflow was meaningfully less than conventional, requiring less acting work time.

Sakornwimon and Leevailoj [14] with the data obtained, concluded that regardless of the impression method used, there is no clinical difference in marginal fit and patient satisfaction was higher for the digital impressions.

Nedelcu et al. [15] concluded that there were considerable variations between scanners with respect to the level of distinction of the cervical terminus and the accuracy of the cervical terminus greater and lesser than conventional impression. The high level of cervical terminus distinction was more related to high resolution localized by cervical terminus accuracy. Topographic variance was low and color precision identification of the cervical end on some scanners. It is indispensable that dentist critically analyze digital impressions, knowing the various technical limitations between scanners, particularly when challenging subgingival conditions apply.

## DISCUSSION

The use of digital technologies such as intraoral scanners has been growing in dentistry to create virtual models of patients and enable CAD/CAM fabrication of esthetic restorations [16].

Digital impressions have some advantages in comparison with conventional impressions, such as the reduction of the time required for the fabrication of restorations and the absence of the need to make plaster impressions after impressions [16], as well as in the study by Sailer et al. [13] where they concluded that the total time laboratory workload for a digital workflow was meaningfully less than for the conventional, as the technician required less acting work time.

Although the benefits of digital impression and CAD/CAM workflow, still exist a large part of clinicians that don't use the digital flow. Some motive may be the result of clinical limitations with these systems, such as intra-arch discrepancy in cases of molding for full-arch prosthesis, sulcus reflection in edentulous patients in complete or partial dentures, and the need for internal adjustments in partial dentures fixed [16].

Corroborating the information above, in Kim and Kim (2018) work the authors concluded that the length of the edentulous zone significantly induced the size of the marginal and internal gap using direct scanning, but considered clinically not significant [5].

Regarding the need for adjustments in fixed partial dentures, studies by Sailer et al. [7] and Moustapha et al. [8] state that the best adaptation was obtained with intraoral scanners, presenting similar or better adjustments than conventional impressions, except in the occlusal and incisal regions, where conventional impressions had more favorable adjustments.

Almeida e Silva et al. [10] study also pointed the intraoral scanner as the best in internal fit compared to conventional impression and states that the marginal fit is clinically acceptable, as in the studies of Su and Sum [12] and Morsy et al. [6].

In contrast, studies by Giachetti et al. [11] and Nedelcu et al. [15], when evaluating the accuracy of impression methods, state that conventional impressions with high-precision impression materials are more accurate than digital impressions and that the precision of digital impressions in relation to the completion of preparations is less.

Regarding patient acceptance and satisfaction regarding the use of conventional or digital impressions, the study by Sakornwimon and Leevailoj [14] had the results that patient contentment with digital impressions was higher in comparison with conventional impressions, comparing the results obtained by Sailer et al. [13] and Sedky and Abd-Elwahab Radi [9] that full-arch impression using conventional impression is less prolonged and favored by dentists and patients in comparison with digital impression.

Therefore, it is possible to observe that most studies showed positive results regarding the use of digital impressions and that in most cases the differences presented were not statistically or clinically significant, being a viable possibility for impressions in dentistry and it is up to the dentist to select the method you prefer and weigh the pros and cons of each type of impression.

## CONCLUSIONS

Both conventional and digital impressions are good methods for taking impressions in fixed partial dentures, each method having its applications, advantages and disadvantages.

Given the limitations, it is up to the dental surgeon to select the impression method to be used, considering the time spent for the impression, the learning curve in relation to the technique that will be used, the personal, practical and social background, in addition to the cost used in acquire materials, clinical hours and laboratory work in the short and long term.

More studies are still needed to relate conventional impressions to digital impressions through both intra and extraoral scanners and to compare them as to the area to be molded, time spent during the entire process, level of dentist experience, costs and investments needed.

## Collaborators

EC Kukulka and JRS Souza, preparation of review and writing. MSS Gomes, OD Andreatta Filho and RS Nishioka, idealization, evaluation, correction and supervision.

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