



# Artificial Intelligence Applications Related to Complete Removable Denture Management: A Systematic Review

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## Abstract

**Introduction:** Prosthetic rehabilitation of edentulous patients remains a challenge in the context of the increasing digitalization of dentistry. In complete removable dentures, limitations are encountered, particularly when using intraoral scanners, due to the absence of stable anatomical landmarks, the difficulty of estimating tissue depressibility, and the need to record both anatomical and functional impressions. **Objective:** To evaluate the contribution of artificial intelligence in different stages related to complete removable denture management. **Methods:** A systematic review was conducted following the PRISMA 2020 guidelines. The literature search was conducted in PubMed, ScienceDirect and Scopus and identified 757 records after duplicate removal from 2020 to 2026. **Results:** Nine studies were included after title, abstract and full text screening, comprising cross-sectional studies, diagnostic studies, quasi-experimental studies, and non-randomized clinical trials. Qualitative assessment was performed using the JBI Critical Appraisal Checklist for Analytical Cross-sectional studies, JBI Critical Appraisal Checklist for Quasi-Experimental Studies and QUADAS-2. **Discussion:** AI in complete removable dentures remains a rapidly growing and evolving field. Its use may be considered at different stages in the management of an edentulous patient requiring complete rehabilitation, particularly during the pre-prosthetic examination, digital impression taking, as well as in aesthetic planning. **Conclusion:** In dentistry, AI is already implemented in several fields. In complete removable dentures, its use remains limited but has been developing in recent years.

## Subject Areas

Dentistry

## Keywords

Artificial Intelligence, Deep Learning, Machine Learning, Temporomandibular Joint Disorders, Mouth Diseases, Computer-Aided Design, Digital Smile Design, Edentulous

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## 1. Introduction

In recent years, artificial intelligence has been applied in several fields, including dentistry. According to the European Commission, “Artificial intelligence refers to systems that display intelligent behavior by analysing their environment and taking actions-with some degree of autonomy-to achieve specific goals.” [1].

It is mainly involved in radiographic analysis for clinical diagnosis. Within the digital workflow, it also has been integrated into intraoral scanners and computer-aided design and manufacturing [2]-[4].

According to The Glossary of Prosthodontic terms, a complete removable denture is defined as “A removable dental prosthesis that replaces the entire dentition and associated anatomy of the maxillae or mandible.” [5].

The goals of prosthetic rehabilitation using a complete removable denture are to restore basic functions and aesthetics and to ensure the physical and psychological comfort of patients [6].

Its implementation using the traditional method, which involves time-consuming and demanding clinical steps, may discourage patients who are mainly elderly individuals.

With the advent of digital technology, it has become possible to make complete removable dentures in a shorter time, which would improve patient comfort, and therefore better satisfaction [7].

The applications of AI are expanding, and its use in pre-prosthetic examination and clinical diagnosis, digital impression taking of edentulous arches, and aesthetic planning is increasingly reported in the literature.

The objective of this systematic review is to determine and describe the contribution of artificial intelligence to the various stages of complete removable denture treatment in the following three areas:

- Pre-prosthetic evaluation in the diagnosis of temporomandibular disorders and lesions of the oral mucosa;
- Optical impression of the edentulous arches;
- Aesthetic planning.

## 2. Material and Methods

### 2.1. Type of Study and PROSPERO Registration

This systematic review was conducted according to the PRISMA 2020 (Preferred Reporting Items for Systematic reviews and Meta analyses) guidelines [8]. The review protocol was registered in advance with PROSPERO under the identifier: **CRD420261338035**.

## 2.2. Search Strategy

The search strategy was structured according to the PICO model (population, intervention, comparison, outcomes). Target population (P): patient with TMD from clinical and radiographic data, clinical oral images of patients with mucosal lesions, and completely edentulous patients. Intervention (I): application of AI in the stages of diagnosis, optical impression taking, and aesthetic planning. Comparison (C) was made for most studies with conventional complete removable rehabilitation management without the application of AI. Outcome (O): focused on the parameters for evaluating the real contribution of AI at the different stages of complete removable denture fabrication. An electronic search was conducted up to March 2026, across three databases, including PubMed, ScienceDirect and Scopus, covering the period from 2020 to 2026.

Keywords used: “Artificial intelligence”, “Deep Learning”, “Machine Learning”, “Temporomandibular Joint Disorders”, “Mouth diseases”, “Computer-Aided design”, “Digital smile design”, “Edentulous”. The Boolean search equations were built from keywords and Boolean operators combining concepts related to artificial intelligence and the different stages involved in complete removable denture fabrication:

### PubMed:

- (“Artificial Intelligence” [Mesh]) AND “Temporomandibular Joint Disorders” [Mesh]) AND “Signs and Symptoms” [Mesh];
- (“Artificial Intelligence” [Mesh]) AND “Temporomandibular Joint Disorders” [Mesh]) AND “Physical Examination” [Mesh];
- (((“Artificial Intelligence” [Mesh]) OR “Deep Learning” [Mesh]) AND “Temporomandibular Joint Disorders” [Mesh]) AND “Diagnosis” [Mesh]) AND “Radiography, Panoramic” [Mesh];
- (“Convolutional Neural Networks” [Mesh]) AND “Mouth Diseases” [Mesh];
- (((“Dental”) “Impression Technique” [Mesh]) AND “Mouth, Edentulous” [Mesh]) AND “Computer-Aided Design” [Mesh];
- “Artificial Intelligence” [Mesh] AND “smile design”;
- “digital smile design” and “artificial intelligence”.

### ScienceDirect:

- Artificial Intelligence and Temporomandibular Joint Disorders and Clinical Signs and Diagnosis;
- Artificial Intelligence and Temporomandibular Joint Disease and Diagnosis and Panoramic Radiography;
- Convolutional Neural Network or Deep Learning and Oral Mucosal Lesions and Diagnosis;
- Edentulous AND intraoral scanner AND artificial intelligence;
- “digital smile design” and “artificial intelligence”.

### Scopus:

- Artificial Intelligence and Temporomandibular Disorder and Clinical Signs;

- Artificial Intelligence AND Temporomandibular Joint Disorders OR Osteoarthritis AND Panoramic Radiography;
- Convolutional Neural Network or Deep Learning and Oral Mucosal Lesions and Diagnosis;
- Edentulous AND intraoral scanner AND artificial intelligence;
- Digital smile design AND artificial intelligence.

### **2.3. Inclusion Criteria**

The inclusion criteria focused on clinical and experimental studies addressing the research question. Original research articles, including randomized and non-randomized clinical trials, cross-sectional studies, diagnostic studies, quasi-experimental studies. Only full-text articles published in French or English were included.

### **2.4. Exclusion Criteria**

The exclusion criteria were as follows: studies not addressing the research question; studies concerning digital applications without the use of artificial intelligence, articles not available in full text, reviews; case reports; letters to the editor; gray literature; expert opinions; editorials; and conference abstracts.

### **2.5. Data Extraction**

Using a predesigned data extraction form, the following information was extracted from the papers that met the eligibility criteria: title, authors' names, year of publication, country/region, study design, sample size, type of AI application, AI model, main performance results, and authors' conclusions.

Because of the methodological heterogeneity of the included studies, a narrative synthesis approach was performed.

### **2.6. Study Selection Process, Qualitative Assessment and Risk of Bias**

All identified articles were imported into Zotero to remove duplicates. Two evaluators independently selected and assessed the data by reviewing titles, abstracts, and full texts. Any disagreements on the selection of studies were discussed and resolved.

The risks of bias in the included studies was assessed using the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies [9] for cross-sectional studies, and using QUADAS-2 [10] for diagnostic studies, and the JBI Critical Appraisal Checklist for Quasi-Experimental Studies [11] for non-randomized clinical trials and quasi-experimental studies.

## **3. Results**

The article selection process was conducted according to the PRISMA 2020 guide-

lines [8]. The detailed sequence is presented in the PRISMA diagram (Figure 1).

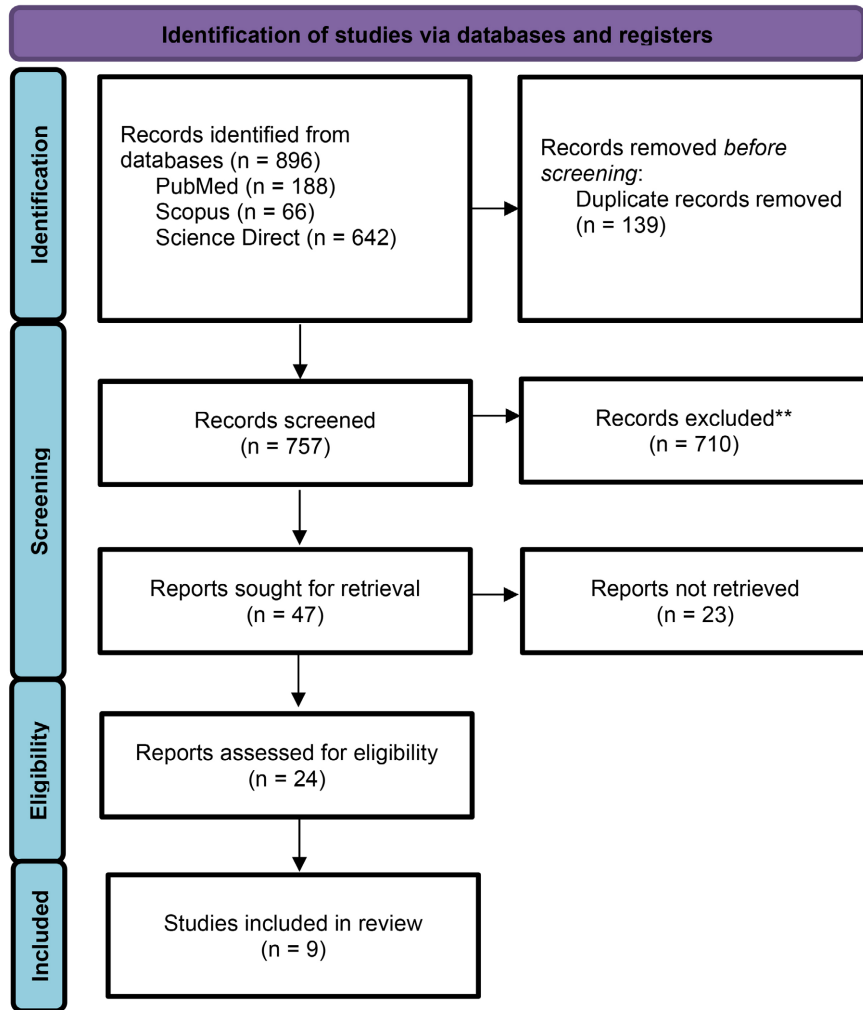


Figure 1. PRISMA flow diagram.

The final selection included nine studies, comprising cross-sectional, diagnostic, quasi-experimental and non-randomized clinical trials studies evaluating the contribution of AI across the three areas of the research objectives.

A table summarizing the data from the selected studies was prepared due to their methodological heterogeneity, Table 1.

Table 1. Table summarizing the different articles selected according to the PICO criteria.

Author, year	Country/Region	Study type	Population	Intervention	Comparison	Results
Yildiz <i>et al.</i> , 2024 [12]	Türkiye	Cross-sectional study	125 patients with TMD 103 patients without TMD	AI models used for the diagnosis of TMDs based on clinical and psychosocial parameters.	Comparison among the AI models.	Among the AI models, the MARS algorithm performed best in diagnosing TMDs.

## Continued

Zou <i>et al.</i> , 2022 [13]	Chinese Mainland	Cross-sectional study	58 patients with TMD and 30 patients without TMD.	An AI model based on ANN was designed to predict TMDs using clinical variables.	Comparison between the ANN and the clinician.	The ANN model demonstrated good accuracy in predicting TMDs. However, it was less accurate than the expert, while outperforming the less experienced clinician
Kim <i>et al.</i> , 2020 [14]	South Korea	Diagnostic study	1000 panoramic images	AI models based on the CNN make it possible to detect the presence or absence of osteoarthritis of the TMJ through analysis of radiographic images.	Comparison among the different models developed to identify TMJ osteoarthritis on a panoramic X-ray.	The models showed a high accuracy rate in detecting TMJ osteoarthritis.
Su <i>et al.</i> , 2024 [15]	Taiwan Region	Diagnostic study	506 clinical images of the oral cavity	A CNN model was used to analyze photographs of the oral cavity for the diagnosis of oral lesions.	N/A	The model demonstrated a high accuracy rate in diagnosing lesions by classifying them as aphthous ulcer, oral candidiasis, lichen planus, precancerous lesions, or oral submucous fibrosis.
Zhou <i>et al.</i> , 2023 [16]	Chinese Mainland	Diagnostic study	785 clinical images of the oral cavity	Development of CNN-based AI models for the classification and localization of aphthous ulcers on clinical oral images.	N/A	The models enabled detection and classification of images into three categories: aphthous ulcer, normal mucosa, and other oral mucosal conditions.
Ceylan <i>et al.</i> , 2023 [17]	Türkiye	Cross-sectional study	628 participants	Generation of smile designs using software with and without AI assistance.	Smile designs created using software without AI assistance versus those created with AI assistance.	Smiles created using software without AI assistance were widely preferred over those designed by AI.
Kaushik <i>et al.</i> , 2025 [18]	India	Cross-sectional study	320 participants	AI-generated and non-AI-generated smile designs.	Smile designs created using software without AI assistance versus those created with AI assistance.	The smiles made by the software without AI assistance were more appreciated than those generated by AI.
Kahya Karaca <i>et al.</i> , 2024 [19]	Türkiye	Non-randomized clinical trial	15 patients with complete edentulism of the maxilla	Conventional impressions and digital impressions were taken using an intraoral scanner with and without the AI-scan option.	Conventional and digital impressions, with and without AI.	A significant difference was observed between AI-scan and non-AI-scan digital impressions.

Continued

Song <i>et al.</i> , 2026 [20]	Chinese Mainland	Quasi- experimental study	2000 facial images, 190 intraoral images.	Development of AI-assisted Motion-DSD software to enable dynamic simulation of the generated smile design.	Conventional DSD methods and Motion-DSD software.	The software performed well in image segmentation and enabled dynamic simulation of the smile.
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TMD: Temporomandibular Disorders, ANN: Artificial Neural Network, AI: Artificial Intelligence, DSD: Digital Smile Design, CNN: Convolutional Neural Network.

The quality of the studies was assessed according to study type.

The risk of bias of the four selected cross-sectional studies and the non-randomized clinical trial study was considered low, as shown in **Table 2** and **Table 3**. However, the risk of bias in the quasi-experimental study and the diagnostic studies was considered moderate, as shown in **Table 3** and **Table 4**.

**Table 2.** Risk of bias assessed by JBI critical appraisal checklist for analytical cross-sectional studies.

Articles	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Total score
Yildiz <i>et al.</i> , 2024	1	1	1	1	0	0	1	1	6
Zhou <i>et al.</i> , 2024	1	1	1	1	0	0	1	1	6
Ceylan <i>et al.</i> , 2023	1	1	1	1	0	0	1	1	6
Kaushik <i>et al.</i> , 2025	1	1	1	1	1	1	1	1	8

**Table 3.** Risk of bias assessed by JBI critical appraisal checklist for quasi-experimental study.

Articles	Is it clear in the study what is the “cause” and what is the “effect” ( <i>i.e.</i> there is no confusion about which variable comes first)?	Were there any comparisons included in any comparisons similar?	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Were the multiple measurements of the outcome, both pre and post the interventions/exposure?	Were the outcomes of participants included in any comparisons measured in the same way?	Were outcomes measured in a reliable way?	Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Was appropriate statistical analysis used?	score
Karaca <i>et al.</i> , 2024	1	1	1	1	1	1	1	1	9

## Continued

Song <i>et al.</i> , 2024	1	0	0	1	0	1	1	N/A	1	5
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**Table 4.** Risk of bias assessed by QUADAS-2.

Study	Patient selection	Index test	Standard reference	Flow and timing
Su <i>et al.</i> , 2024	High	Low	Unclear	Unclear
Kim <i>et al.</i> , 2020	High	Low	Low	Unclear
Zhou <i>et al.</i> , 2023	High	Low	Low	Low

In the context of predicting temporomandibular disorders based on various clinical signs and symptoms associated with psychological factors, the MARS algorithm demonstrated an accuracy of 89.66% compared with other machine learning algorithms [12].

In addition, a model based on artificial neural networks (ANNs) enabled the gradual refinement of these predictions and demonstrated an average sensitivity of 92.31%, an average specificity of 88.89% and an accuracy of 90.91% [13].

Other studies developed algorithms capable of diagnosing certain temporomandibular disorders, such as temporomandibular joint (TMJ) osteoarthritis, by analyzing panoramic radiographs using convolutional neural network (CNN) technology, which exhibits a sensitivity of 54%, a specificity of 94% and an accuracy of 84% for classifying radiographs into healthy condyle and osteoarthritis [14].

For the diagnosis of mucosal lesions, all selected studies relied on clinical photographs to demonstrate the accuracy of the AI models used in their detection, classification and categorization. The detection accuracy of these lesions could reach 98.7% with the YOLOV5 model. Regarding classification, accuracy varied depending on the model used, ranging from 88.8% to 92.86% as reported for the ResNet50 model. Oral lesions were classified into aphthous ulcer, oral candidiasis, lichen planus, precancerous lesions, oral submucous fibrosis, normal mucosa, and other oral mucosal conditions [15] [16].

A comparison between conventional impressions and digital impressions of edentulous arches taken with and without the AI scan option, showed no significant difference between digital impression without AI assistance and the conventional impression. However, a significant difference was observed between the digital impressions with AI-scan and those without AI-scan [19].

For dynamic smile simulation, some studies demonstrated the ability of AI to assist software such as Motion-DSD in segmenting facial structures and maxillary anterior teeth for image alignment and subsequently for generating a dynamic smile design. The mean Dice coefficient revealed a value of 0.886 for facial structures and 0.969 for teeth reflecting good performance [20].

However, several studies that compared participants perceptions of smiles designs generated by software with and without AI assistance showed a preference

for designs created without AI assistance [17] [18].

## 4. Discussion

### 4.1. Discussion of the Methodology and Results

This systematic review was conducted according to the PRISMA 2020 guidelines [8]. The methodology has certain limitations including the use of only three databases, and the inclusion of only full-text articles published in English or French. The selected studies, their protocols, and their research conditions were heterogeneous. The studies included cross-sectional, diagnostic, quasi-experimental study and non-randomized clinical trial designs. This heterogeneity is explained by the fact that the objectives of this review were divided into three predefined areas: pre-prosthetic examination, digital impression taking and aesthetic planning. Consequently, the populations, interventions and outcomes varied across studies. Furthermore, although some studies did not directly include or focus on completely edentulous patients, they were included because they were considered relevant to the complete denture management pathway, such as pre-prosthetic examination and aesthetic planning prior to prosthetic rehabilitation.

Finally, the risk of bias was low for the cross-sectional studies and the non-randomized clinical trial, and moderate for the diagnostic studies and the quasi-experimental study. Therefore, the results should be interpreted with caution because of these methodological limitations.

### 4.2. The Contribution of AI in the Management of Complete Removable Dentures

Temporomandibular disorders (TMDs) are among the most common musculoskeletal conditions affecting the TMJ, masticatory muscles and adjacent structures. They manifest through a set of clinical signs and symptoms [21]. During the clinical examination of an edentulous patient, it is important to assess the presence or absence of TMD.

TMDs are characterized by a combination of signs and symptoms, which can make diagnosis difficult. By analyzing clinical datasets, AI could assist in the diagnosis of these disorders. The developed models could serve as a diagnostic tool, particularly for less experienced clinicians [12] [13].

Clinical signs alone are often insufficient for an accurate diagnosis; therefore, additional examinations are necessary.

Panoramic radiographs are often used as the first-line imaging modality when TMJ osteoarthritis is suspected. Although this technique has limitations for the precise visualization of TMJ structures, CNN-based models have been developed to detect the presence or absence of osteoarthritis. However, panoramic radiography does not allow for the accurate identification of bone changes associated with this condition. In this context, cone beam computed tomography (CBCT) appears to be more suitable for diagnosis. Nevertheless, studies on the diagnosis of TMJ osteoarthritis from panoramic radiographs remain limited. Although

CBCT can provide more relevant results, its high cost and radiation dose restrict its use [14].

Before any prosthetic rehabilitation, an accurate diagnosis must be established to enable appropriate patient management. Preparation of the oral mucosa is necessary in cases of lesions, which are common and can manifest in various forms [22]. The development of CNN models capable of detecting, classifying and categorizing oral mucosal lesions based on intraoral photographs represents a significant advancement, and can serve as a complementary diagnostic aid [15] [16].

Regarding digital impressions for complete removable dentures, this topic is not widely discussed in the literature, and even less so in relation to AI scanning. Digital impressions are not initially recommended for edentulous patients because of tissue duality and the lack of stable anatomical landmarks [19].

Aesthetic planning is an important step in complete removable denture treatment. It allows the patient to visualize and approve the proposed prosthetic design while facilitating communication between the clinician and the laboratory technician. Smile design is a preoperative digital approach that enables virtual visualization of the future smile generated by digital smile design software [23] [24].

Some smile design software now incorporates artificial intelligence to optimize several stages of smile design, such as facial recognition, face type analysis, determination of the ideal tooth position, and personalized selection of tooth size. However, according to the findings of this review, further progress is still needed to optimize AI-assisted smile design software, and human intervention remains necessary in this field [17] [18].

### **4.3. Limitations of the Review**

This review has several limitations. There is a significant lack of studies dedicated to artificial intelligence in complete removable dentures. Most identified applications corresponded to adjunct AI-assisted procedures related to complete removable denture management, such as diagnostic support or aesthetic planning.

Completely edentulous patients are often underrepresented in the literature. In the rare studies where this type of patient is included, the focus is often on implant-supported fixed full-arc prosthetic rehabilitation, a field in which research is more abundant and diverse. However, such studies do not align with the objective of this review, which focuses on conventional complete removable dentures.

Regarding CAD/CAM, for the digital design of the complete removable dentures, the available studies describing this process do not explicitly mention the use of software integrating AI in complete removable dentures. Conventional and digital steps still go hand in hand, and a hybrid approach remains necessary to date, which limits the possibilities for full AI integration.

### **4.4. Future Prospects**

These primarily concern the possibility of creating static and dynamic digital impressions of the edentulous arch that could be used for the design of a complete

removable denture, with the aim of digitizing all conventional steps and achieving a fully digital workflow.

The integration of AI in the automatic detection of anatomical landmarks, the personalized selection of teeth, and their positioning on the edentulous arch, which is still performed manually by the laboratory technician despite the digitalization of complete removable denture fabrication, could represent a true revolution in this field.

## 5. Conclusions

In light of this systematic review, AI appears as a promising tool in pre-prosthetic examination, optical impression taking and aesthetic planning which constitute different stages of the management in complete removable dentures.

However, the application of AI remains less developed in conventional digitized complete removable dentures compared to other disciplines where data is more abundant and advances are faster, as is the case with implant-supported dentures, which constitute the most well-documented field.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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