

# Construction and Application of Standardized Process for Digital Denture Design and Manufacturing from the Perspective of Dental Technicians

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**Abstract:** Digital technology has driven technological innovation in the field of oral restoration. Digital denture design and fabrication, with its advantages of high precision, high efficiency, and strong personalization, has become the mainstream in the industry. The operational standardization of dental technicians directly determines the final quality of the denture. This article, from the perspective of dental technicians, explores the construction principles and core steps of the standardized process for digital denture design and fabrication, analyzes the clinical application value, practical points, and existing problems of process standardization, and proposes targeted optimization strategies to provide practical references for standardizing technicians' digital operations, improving denture production quality, and promoting the standardization development of the digital oral restoration industry.

**Keywords:** dental technician; digital denture; design and fabrication; standardized process; oral restoration

## 1. Introduction

The core goal of oral restoration is to restore patients' oral functions and facial aesthetics. The accuracy and fit of denture production are the key to achieving this goal. Traditional denture design and fabrication rely on technicians' manual operations and clinical experience, which have defects such as long production cycles, large individual errors, and poor product consistency, making it difficult to meet the precise and standardized requirements of modern oral restoration. The deep application of digital technologies such as intraoral scanning, CAD/CAM, and 3D printing has transformed denture production from "empirical manual operation" to "data-driven precise manufacturing".

Dental technicians are the core executors of digital denture design and fabrication, undertaking key tasks such as data processing, model design, denture processing, and post-processing adjustments. Their operational proficiency with digital equipment and the degree of design standard control directly affect the quality of denture production and clinical fit. Currently, the development of digital oral restoration in China is rapid, but there are significant differences in the operation processes and execution standards among different institutions, which restricts the overall improvement of denture quality. Therefore, from the perspective of dental technicians, constructing a scientific, standardized, and implementable standardized process is of great practical significance for unifying operation norms, reducing human errors, and improving denture production quality.

## 2. Construction Principles of the Standardized Process for Digital Denture Design and Fabrication

From the perspective of dental technicians, the construction of the standardized process is centered on "precision, standardization, efficiency, and fitability", while also taking into account the practicality and operability of the operation. It consists of five principles:

**Data Precision Principle:** Data is the foundation of digital fabrication. Ensure the accuracy and completeness of data throughout the process, clearly define data processing standards, and avoid design errors caused by data deviations;

**Operational Standardization Principle:** Establish unified technical standards for equipment operation, software use, denture processing, etc., and clearly define operation points and quality control nodes;

**Process Connection Principle:** Clearly define the work content and handover standards between clinicians and technicians to ensure seamless connection of data transmission, plan communication, and product delivery;

**Quality Control Principle:** Set multiple quality inspection nodes, clearly define inspection standards and handling methods for non-conforming products, and achieve full-process quality traceability and control;

**Adapt to Clinical Needs Principle:** Closely combine clinical restoration requirements, take into account the physiological function of the denture and the individual needs of patients, and ensure that the denture meets clinical fit requirements.

### 3. Core Steps of the Standardized Process for Digital Denture Design and Fabrication

The entire process of digital denture design and fabrication is divided into five core steps. Dental technicians undertake the leading operations in each step, and the standardized operation of each step is the core guarantee of denture quality.

#### 3.1 Clinical Data Reception and Review

Technicians first establish a standardized data handover list, clearly defining the types, formats, and precision requirements of intraoral scanning, jaw position relationship records, facial aesthetic data, and restoration design sheets. Then, they conduct standardized reviews of the data, checking the completeness of the scanning data, the accuracy of jaw position relationship parameters, verifying the core information of the restoration design sheet, establishing a standardized feedback process for unqualified data, communicating and supplementing corrections with clinicians in a timely manner to ensure the accuracy and completeness of data entering the design stage.

Digital Model Design Based on CAD software, a standardized design process is established. Technicians first perform preprocessing such as noise reduction, edge smoothing, and tissue surface optimization on the scanned data that has been approved for review, ensuring that the digital model is highly consistent with the actual patient's oral cavity. Then, according to different types of dentures (such as complete dentures, fixed dentures, and removable partial dentures), they formulate standardized design specifications for core parameters such as artificial tooth arrangement, baseplate shape, and retention body design. Finally, they simulate occlusion movements through software to optimize the occlusion design, ensuring that there is no interference in centric, protrusive, and lateral occlusions. After the design is completed, technicians review the plan according to the standardized self-check list to ensure compliance with clinical and production standards.

#### 3.2 Denture processing and fabrication

Based on the type and material of the denture, a standardized processing flow for CAM cutting, 3D printing, and casting is established, and the processing parameter standards for different materials (such as resin, zirconia, and metal frameworks) are clarified. Technicians strictly follow the equipment operation specifications, perform daily calibration and maintenance to avoid processing errors caused by equipment precision deviations, and conduct preliminary quality inspections on the processed blanks to check the consistency of shape, size, and thickness with the design, and promptly correct processing deviations.

#### 3.3 Post-processing and testing

Establish a standardized post-processing process and multi-dimensional quality inspection system. In the post-processing stage, operations such as tissue surface grinding and polishing, artificial tooth shape adjustment, baseplate edge smoothing, and fine adjustment of the occlusal surface are carried out according to the type of denture, taking into account both the practicality and aesthetics of the denture. In the testing stage, size accuracy, shape compatibility, and occlusal balance are tested. Unqualified dentures are subject to standardized rework procedures, with clear rework requirements and retesting standards to ensure that the finished product meets the quality standards.

#### 3.4 Product delivery and clinical adaptation guidance

Technicians prepare standardized delivery lists, clearly stating information such as denture type, quantity, material, and test results, and make delivery records and deliver the dentures to the clinical physicians. At the same time, they conduct standardized technical communication with the clinical physicians, explaining the design key points, process characteristics, and maintenance requirements of the dentures, providing standardized adjustment suggestions for potential problems during clinical trial wear, and providing basic guidance on the use and maintenance of the dentures for patients.

### 4. Clinical Application Value and Practical Points of the Standardized Process

#### 4.1 Clinical Application Value

The standardized process has significant value for technicians, medical institutions, and the industry: for technicians, it clarifies operation and quality standards, reduces empirical errors, and improves operational efficiency and denture production quality; for medical institutions, it enables full process quality traceability, reduces denture rework rates, improves patient satisfaction, promotes collaborative medical-technical work, and enhances overall efficiency of diagnosis and treatment; for the industry, it promotes the unification of industry standards for digital denture design and fabrication, promotes industry standardization and normalization, and enhances the overall technical level of digital oral restoration in China.

#### 4.2 Practical Points

In the application of the process, technicians need to grasp three core points: First, strengthen digital training and

proficiently master the operation and quality control standards of digital equipment and software, and regularly participate in technical exchanges to improve problem-solving capabilities; Second, strictly implement quality control standards, conduct self-checks and mutual checks at each stage to ensure the implementation of the testing nodes and eliminate non-conforming products from entering the next process; Third, strengthen collaborative communication with clinical physicians, actively respond to clinical restoration needs, establish an efficient communication and feedback mechanism, and achieve a high degree of alignment between design production and clinical needs.

## 5. Existing Problems and Optimization Strategies

At present, there are still some problems in the practice of the standardized process, such as weak standardized awareness among some technicians, non-standard operation of digital equipment and software, and poor process coordination among different institutions. The targeted optimization strategies are as follows:

Strengthening standardized awareness cultivation: Through industry training and internal institution assessments, integrate the standardized process into the daily operations of technicians, and enhance their standardized operation awareness; Establish a standardized assessment system: Set up assessment standards for each operation phase, conduct regular assessments of technicians' operational behaviors and production quality, link the assessment results with career development, and force the process to be implemented;

Promote the unified promotion of industry standards: Led by the oral health association, based on clinical and technicians' practical experience, formulate unified industry standards nationwide. Through technical training, exchanges, etc., promote the implementation, achieving uniform operation processes for institutions and technicians.

## 6. Conclusion

Digital technology has brought revolutionary changes to denture design and production. The degree of standardization of technicians' operations directly determines the quality and clinical fit of digital dentures. The standardized process constructed from the perspective of technicians, including "clinical data reception and review - digital model design - denture processing and production - post-processing and testing - product delivery and clinical fit guidance", clearly defines the operation norms and quality standards for each phase, effectively reducing human errors, improving production accuracy and efficiency, and lowering the rework rate.

In clinical practice, technicians need to strengthen their awareness of standardized operations, master digital technology and process requirements, strictly implement quality control, and enhance communication between medical and technical staff. In the future, with the development of technologies such as artificial intelligence, big data, and new 3D printing materials, the standardized process needs to be continuously optimized and improved, and technicians need to continuously enhance their digital skills and comprehensive qualities. Through the promotion and optimization of the standardized process, it will further promote the digital oral restoration industry to develop in a standardized and precise manner, providing patients with higher-quality and more personalized oral restoration services.

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