

DIGITAL WORKFLOW IN OBTURATOR FABRICATION: A NARRATIVE REVIEW

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Abstract

Maxillary defects resulting from surgical resection, trauma, or congenital abnormalities can significantly impair speech, mastication, swallowing, and esthetics. Conventional obturator fabrication techniques are often complex, time-consuming, and highly technique-sensitive. The advent of digital dentistry has introduced innovative approaches involving intraoral scanning, computed tomography (CT), computer-aided design/computer-aided manufacturing (CAD/CAM), and three-dimensional (3D) printing technologies. These advancements have enabled clinicians to improve treatment efficiency, accuracy, and patient comfort. This review summarizes the current evidence regarding digital workflows in obturator fabrication and discusses their advantages, limitations, and future prospects.

Keywords: Obturator, CAD/CAM, Digital Dentistry, 3D Printing, Maxillofacial Prosthodontics

Introduction

Maxillary defects create communication between the oral and nasal cavities, resulting in compromised speech, swallowing, mastication, and facial esthetics. Obturator prostheses remain the most commonly used method for

rehabilitation of these patients. Conventional techniques involve multiple clinical and laboratory procedures and are often associated with patient discomfort and inaccuracies¹.

Recent advances in digital dentistry have transformed maxillofacial prosthodontics by enabling virtual treatment planning, digital impression making, CAD-based prosthesis design, and additive manufacturing techniques². Studies have demonstrated that digital workflows can reduce treatment time, improve patient comfort, and enhance reproducibility of prostheses³.

Digital Data Acquisition

The first step in digital obturator fabrication is acquisition of anatomical information through intraoral scanners, CT, CBCT, and facial scanning systems. Digital impressions eliminate many shortcomings associated with conventional impression materials and techniques⁴.

Tasopoulos et al. described the use of intraoral scanning combined with postoperative CT data to fabricate a two-piece hollow bulb obturator. The authors reported improved patient comfort and satisfactory clinical accuracy while avoiding conventional impression procedures⁵.

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Digital scanning is particularly beneficial in patients with severe trismus, extensive defects, or limited mouth opening, where conventional impression making is challenging⁶.

Computer-Aided Design (CAD)

Following data acquisition, the digital files are imported into CAD software for virtual design of the prosthesis. CAD software allows visualization of undercuts, defect morphology, and framework design before manufacturing⁷.

Virtual planning facilitates modifications without repeating clinical procedures and improves communication among prosthodontists, surgeons, and laboratory technicians².

Additive Manufacturing and 3D Printing

Three-dimensional printing has emerged as a major advancement in obturator fabrication. Additive manufacturing enables fabrication of lightweight hollow obturators with complex geometries that are difficult to achieve using conventional laboratory techniques⁸.

Koyama et al. presented a workflow that integrated optical scanning and digital molding technologies to fabricate a single-piece hollow obturator, simplifying laboratory procedures and minimizing fabrication errors⁹.

Recent reports have demonstrated successful fabrication of obturators using resin-based printers, selective laser sintering, and polyetheretherketone (PEEK) frameworks⁵.

CAD/CAM Obturators

CAD/CAM technology enables both additive and subtractive manufacturing approaches. Milled prostheses offer improved material homogeneity and mechanical properties, whereas printed prostheses provide greater flexibility in design⁷.

Digital and cast-free workflows have recently

been introduced, allowing fabrication of definitive hollow obturators without conventional stone casts. Such approaches reduce laboratory errors and improve overall treatment efficiency¹⁰.

Surgical Obturators

Digital technology has also facilitated the fabrication of surgical obturators. Through virtual surgical planning and preoperative digital design, prostheses can be fabricated before surgery and delivered immediately following maxillectomy procedures¹¹.

This approach minimizes rehabilitation time and improves postoperative patient management.

Advantages of Digital Workflow

The major advantages reported in the literature include^{1,3}:

- Improved patient comfort during impression procedures
- Reduced number of clinical appointments
- Enhanced prosthesis accuracy
- Improved reproducibility
- Digital storage of patient records
- Better interdisciplinary communication
- Reduced material waste

Systematic reviews have concluded that digital workflows significantly reduce working time while enhancing patient acceptance and satisfaction¹¹.

Limitations

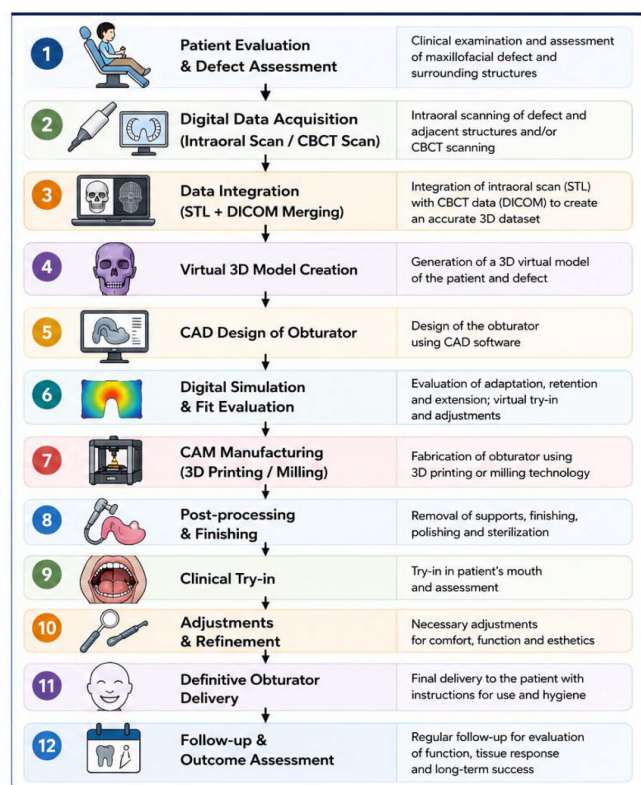
Despite promising results, several limitations remain^{1,3}:

- High initial investment cost
- Requirement for specialized training
- Difficulty in capturing deep undercuts

- Limited availability of dedicated maxillofacial software
- Insufficient long-term clinical evidence

Most available evidence consists of case reports and technical reports, highlighting the need for randomized clinical studies.

Digital Workflow in Obturator Fabrication



Future Perspectives

Future developments may include artificial intelligence-assisted design, automated CAD workflows, advanced printable biomaterials, and integration of augmented reality technologies.¹²

Digital workflows are expected to become increasingly accessible and may eventually become the standard approach for maxillofacial prosthetic rehabilitation.

Conclusion

Digital workflows have significantly transformed obturator fabrication. The combination of digital scanning, CAD design, and additive manufacturing offers improved accuracy, efficiency, patient comfort, and reproducibility compared with conventional methods. Although challenges remain, current evidence suggests that digital technologies represent a promising future direction for maxillofacial prosthodontics.

References

1. Punia V, Ghuge VM, Porwal A, Salgia P. Application of digital technology for fabricating the obturator in rehabilitation of maxillary defect: a systematic review. *J Popul Ther Clin Pharmacol*. 2025;32(2):114–122.
2. Ye H, Wang Z, Sun Y, Zhou Y. Fully digital workflow for the design and manufacture of prostheses for maxillectomy defects. *J Prosthet Dent*. 2021;126(2):257–261.
3. Paul A, Dhawan P, Jain N. Digital applications in the fabrication of obturators in maxillectomy defects: a systematic review. *Cureus*. 2024;16(9):e70479.
4. Park JH, Lee KS, Lee JY, Shin SW. Fabricating a maxillary obturator using an intraoral digital impression: a case history report. *Int J Prosthodont*. 2017;30(3):266–268.
5. Tasopoulos T, Chatziemmanouli D, Kouveliotis G, Karaiskou G, Wang J, Zoidis P. PEEK maxillary obturator prosthesis fabrication using intraoral scanning, 3D printing and CAD/CAM. *Int J Prosthodont*. 2020;33(3):333–340.
6. Das S, et al. Digital technology to fabricate surgical obturator in patients with limited mouth opening. *J Indian Prosthodont Soc*. 2023;23(4):412–417.
7. Michelinakis G, Pavlakis M, Igoumenakis D. Rehabilitation of a maxillectomy patient using intraoral scanning impression technology and CAD/CAM fabricated obturator prosthesis. *J Indian Prosthodont Soc*. 2018;18(Suppl 1):S85–S86.
8. Jamayet NB, Farook TH, Al-Oulabi A, Johari Y, et al. Digital workflow and virtual validation of a 3D-printed definitive hollow obturator for a large palatal defect. *J Prosthet Dent*. 2023;129(5):798–804.
9. Koyama S, Kato H, Harata T, Sasaki K. A workflow for fabricating a hollow obturator by using 3D digital technologies. *J Prosthet Dent*. 2020;124(6):644–649.
10. Ma D, Wang X, Zhang T, Bai S. A digital and cast-free workflow for fabricating a definitive hollow obturator prosthesis for a maxillectomy defect. *J Prosthet Dent*. 2025;133(1):88–94.
11. Callahan D, et al. CAD/CAM surgical obturator without impressions to restore a maxillectomy defect. *J Prosthodont*. 2021;30(8):722–726.
12. Khorsandi D, Fahimipour A, Abasian P, et al. 3D and 4D printing in dentistry and maxillofacial surgery: a review. *J Mater Res Technol*. 2021;15:4561–4586.