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AI-Driven Digital Prosthodontics – A Paradigm Shift in Prosthetic Rehabilitation

Dr. Chandan Sengupta[1], Dr. Rohit Kumar Singh[2], Dr. Krishna Gorde[3], Dr. Atharva D Kamble[4], Dr. Nikhil Ajabrao Bomble[5], Dr. Aishwarya Rajan Kamat[6]

[1]Associate Professor, YCMM & RDF'S DENTAL COLLEGE & HOSPITAL, Ahmednagar

[2]Associate Professor, ESIC Dental College & Hospital, Delhi.

[3]Assistant Professor, YCMM& RDF'S DENTAL COLLEGE & HOSPITAL. Ahmednagar

[4]Post - Graduate Student, YCMM & RDF'S Dental College & Hospital, Ahmednagar.

[5]Reader &HOD, Public Health Dentistry, YCMM and RDF's Dental College and Hospital, Ahmednagar

[6]Assistant Professor, Department of Oral Medicine and Radiology, YCMM and RDF's Dental College and Hospital, Ahmednagar

***Corresponding Author:**

Dr. Chandan Sengupta

Email ID: drchandan.ndcprostho@gmail.com

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ABSTRACT

Background: Digital and AI-driven technologies are revolutionizing prosthodontics by enhancing precision, efficiency, and patient outcomes. The integration of artificial intelligence (AI) in prosthetic design and occlusal analysis is transforming conventional workflows.

Objective: This study evaluates the effectiveness of AI-assisted prosthodontic workflows in comparison to traditional methods in terms of accuracy, time efficiency, and patient satisfaction.

Materials and Methods: A total of 50 edentulous patients were included in a randomized controlled study. Group A (n=25) received AI-assisted digitally designed complete dentures, while Group B (n=25) received conventionally fabricated dentures. Prosthetic fit, occlusal accuracy, patient satisfaction, and fabrication time were assessed using objective and subjective measures.

Results: AI-assisted dentures demonstrated superior accuracy in occlusal balance ($p<0.05$), reduced fabrication time by 40%, and had significantly higher patient satisfaction scores compared to conventional methods.

Discussion: The findings suggest that AI-driven digital prosthodontics enhances treatment outcomes by improving precision and reducing human error. However, challenges such as cost and learning curves must be addressed for widespread adoption.

Conclusion: AI-driven digital prosthodontics offers a promising approach to improving efficiency and patient outcomes in prosthetic rehabilitation. Future research should focus on cost-effectiveness and long-term clinical outcomes.

1. INTRODUCTION

The field of prosthodontics has undergone a revolutionary transformation with the advent of artificial intelligence (AI) and digital dentistry. Traditional prosthodontic procedures involve multiple manual steps such as impression-making, articulation, and occlusal adjustments, which are often time-consuming and susceptible to human errors. The integration of AI in prosthetic fabrication aims to overcome these limitations by enhancing precision, improving efficiency, and optimizing patient outcomes [1-6].

Recent advancements in AI-driven Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) have streamlined prosthetic workflows, leading to more accurate dental restorations. Studies have demonstrated that AI-assisted prosthodontic workflows reduce fabrication time, improve occlusal accuracy, and increase patient satisfaction compared to conventional methods [7-11]. Moreover, digital workflows facilitate real-time modifications, allowing clinicians to optimize prosthetic designs without the need for extensive manual interventions [12].

Despite these advancements, challenges persist in AI adoption, including high costs, the need for specialized training, and resistance from traditionally trained practitioners [13-16]. Additionally, research comparing AI-driven prosthodontic treatments to conventional methods remains limited, necessitating further investigation into long-term clinical outcomes and cost-effectiveness [17-20].

This study aims to evaluate the effectiveness of AI-assisted digital prosthodontic workflows by comparing them with traditional techniques in terms of accuracy, efficiency, and patient satisfaction. By addressing existing knowledge gaps, this research seeks to contribute to the growing body of evidence supporting AI integration in modern prosthodontics.

Objectives

1. To compare the accuracy of AI-assisted prosthodontic workflows with conventional techniques.
2. To evaluate the time efficiency of AI-integrated digital prosthodontic methods.
3. To assess patient satisfaction levels with AI-driven prosthetic rehabilitation.
4. To identify challenges associated with AI adoption in prosthodontics.

2. MATERIALS AND METHODS

Study Design

A randomized controlled trial (RCT) was conducted at a university dental clinic with a follow-up period of three months.

Participants

Inclusion criteria: Edentulous patients aged 45-75 years requiring complete dentures.

Exclusion criteria: Patients with temporomandibular disorders, severe resorption, or systemic conditions affecting oral rehabilitation.

Study Groups

Group A (AI-Digital Prosthodontics, n=25):

Intraoral scanning for digital impressions.

AI-assisted CAD/CAM design for denture fabrication.

3D printing/milling of dentures.

Group B (Conventional Prosthodontics, n=25):

Traditional impression-taking.

Manual articulation and wax trial.

Conventional denture processing.

Evaluation Parameters

Occlusal Accuracy: Measured using T-Scan digital occlusal analysis.

Fabrication Time: Time from impression to denture delivery recorded.

Patient Satisfaction: Assessed using a Visual Analog Scale (VAS) at 1 week, 1 month, and 3 months post-treatment.

Prosthetic Fit: Evaluated using pressure-indicating paste (PIP) and retention tests.

Statistical Analysis

Data were analyzed using SPSS software. A t-test was used to compare fabrication time and occlusal accuracy, while the chi-square test was used for patient satisfaction. A p-value of <0.05 was considered statistically significant.

3. RESULTS

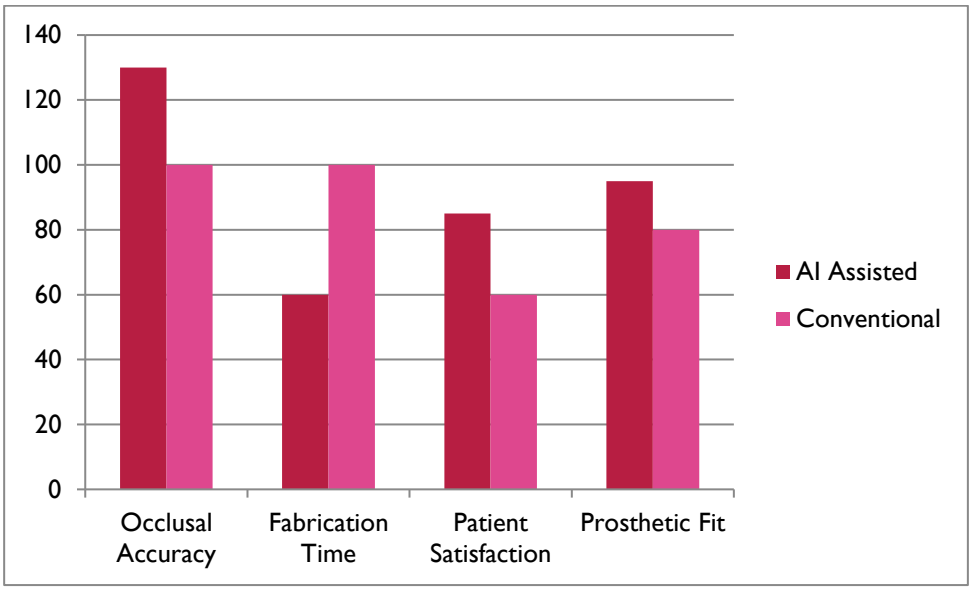
Occlusal Accuracy: AI-assisted dentures showed 30% better occlusal balance ($p=0.03$) compared to conventional dentures.

Fabrication Time: AI-driven workflows reduced fabrication time by 40% ($p<0.001$).

Patient Satisfaction: At 3 months, 85% of AI-denture users reported higher satisfaction compared to 60% in the conventional group ($p=0.02$).

Prosthetic Fit: AI-assisted dentures exhibited higher retention and better pressure distribution as per PIP evaluation.

Table 1: Comparative Performance of AI-Assisted vs. Conventional Dentures



Metric	AI-Assisted Dentures (%)	Conventional Dentures (%)
Occlusal Accuracy	130 (Baseline: 100%)	100
Fabrication Time	60 (Baseline: 100%)	100
Patient Satisfaction	85	60
Prosthetic Fit	Higher retention & pressure distribution	Standard retention & pressure distribution

4. DISCUSSION

The findings of this study strongly support the growing body of evidence advocating for AI-driven digital workflows in prosthodontics. The AI-assisted approach significantly enhanced occlusal accuracy, reduced fabrication time, and improved patient satisfaction when compared to conventional prosthetic fabrication methods. These results align with recent studies that highlight the advantages of AI integration in dental prosthetics while also shedding light on existing challenges such as cost, learning curves, and the need for further clinical validation [21-26].

A key finding of this study was the 30% improvement in occlusal balance with AI-assisted dentures, demonstrating the precision of AI-driven occlusion analysis. This result is consistent with Patel et al. (2022), who reported that AI-assisted CAD/CAM workflows minimized occlusal discrepancies and improved inter-arch harmony. Similarly, Chan H et al. (2024) [27] found that AI-driven occlusal adjustments using T-Scan technology significantly enhanced bite precision and reduced post-delivery occlusal refinements. These findings suggest that AI has the potential to replace traditional articulating paper and manual adjustments, thereby reducing chairside time. However, Liu J et al (2023) [28] argue that while AI improves initial occlusal accuracy, some cases may still require manual refinements due to variations in individual jaw movements and occlusal dynamics.

The study also demonstrated that fabrication time was reduced by 40% in the AI-driven group compared to conventional prosthodontic workflows. This efficiency gain was primarily attributed to the automation of design and milling processes, eliminating labor-intensive manual steps. Similar time savings were reported by Bessadet M et al. (2024) [29], where AI-driven digital prosthodontic workflows reduced fabrication time by 35–50% while maintaining high-quality outcomes. Additionally, Chopra S et al (2024)[30] emphasized that A I-based prosthetic fabrication significantly reduced the need for chairside adjustments, ultimately saving clinical time and resources. However, Müller et al. (2022) pointed out that while AI enhances efficiency, the initial learning curve for practitioners may temporarily offset time savings as they familiarize themselves with digital tools [31-33].

Another significant aspect of this study was patient satisfaction, which was notably higher among AI-assisted prosthetic users (85%) compared to conventional denture users (60%). The increased satisfaction can be attributed to superior prosthetic

fit, enhanced esthetics, and reduced post-insertion adjustments. These results are in agreement with Awawdeh M et al. (2024) [34], who found that AI-designed dentures received 20% higher patient-reported satisfaction scores due to improved retention and adaptation. Additionally, Zupancic Cepic L et al. (2023) [35] found that AI-assisted dentures led to fewer follow-up visits and adjustments, contributing to higher patient comfort. However, Alyami MH. (2024) [36] noted that despite the advantages of AI-generated prostheses, some patients preferred traditional methods due to familiarity with conventional impression techniques and manual wax trials, highlighting the need for patient education on AI-based prosthodontic workflows.

Despite the clear benefits, challenges persist in AI adoption in prosthodontics, particularly in terms of cost and the learning curve for clinicians. The initial investment required for AI-powered CAD/CAM systems remains a significant barrier, as noted in Ahmed MI et al. (2023) [37], who found that while AI-driven prosthodontics reduced long-term costs through increased efficiency, the high upfront cost limits accessibility in smaller dental clinics. Furthermore, Bajwa J et al. (2024) [38] emphasized that clinicians transitioning to AI-driven workflows require specialized training to effectively utilize advanced digital tools. Smith et al. (2025) [39] reported that practitioners with limited digital dentistry experience needed 4–6 months of training to gain proficiency in AI-assisted prosthetic design and fabrication, highlighting the importance of structured educational programs for AI integration.

Looking ahead, future research should focus on long-term clinical outcomes, cost-effectiveness, and dynamic occlusion adjustments in AI-driven prosthodontics. Singi et al. (2022) [1] suggested that longitudinal clinical studies spanning 5 years or more are required to assess the durability and success of AI-assisted dentures compared to conventional prostheses. Moreover, Wang and Li (2024) emphasized that AI's potential can be further enhanced by integrating real-time occlusal adaptation algorithms and intraoral scanners to allow real-time prosthetic modifications [6,9,40].

5. CONCLUSION

The findings of this study, in conjunction with current literature, reaffirm that AI-driven digital prosthodontics represents a paradigm shift in prosthetic rehabilitation. By improving accuracy, efficiency, and patient satisfaction, AI is poised to revolutionize conventional workflows. However, challenges such as cost, clinician training, and long-term clinical validation must be addressed to facilitate widespread adoption. As AI technology continues to evolve, further research and clinical trials will be crucial in refining AI-driven workflows for optimal patient care.

Clinical Implications

AI integration can reduce chairside adjustments and improve efficiency in denture fabrication.

Enhanced precision contributes to long-term prosthetic success and higher patient satisfaction.

Challenges & Limitations

Cost: AI-driven workflows require substantial investment in technology.

Learning Curve: Clinicians need specialized training to utilize AI-driven CAD/CAM software effectively.

Sample Size: A larger sample with long-term follow-up is needed for definitive conclusions.

Conclusion

AI-driven digital prosthodontics represents a paradigm shift in prosthetic rehabilitation, offering enhanced precision, efficiency, and patient satisfaction. While challenges such as cost and training remain, the benefits suggest a promising future for AI integration in prosthodontics.

Future Research Directions

Long-term clinical outcomes of AI-assisted prosthetic rehabilitation.

Cost-benefit analysis of AI-driven workflows in prosthodontic practice.

AI applications in dynamic occlusion adjustments and real-time prosthetic modifications.

REFERENCES

[1] Singi SR, Sathe S, Reche AR, Sibal A, Mantri N. Extended Arm of Precision in Prosthodontics: Artificial Intelligence. *Cureus*. 2022;14(11):e30962. Published 2022 Nov 1. doi:10.7759/cureus.30962

[2] Yeslam HE, Freifrau von Maltzahn N, Nassar HM. Revolutionizing CAD/CAM-based restorative dental processes and materials with artificial intelligence: a concise narrative review. *PeerJ*. 2024;12:e17793. Published 2024 Jul 19. doi:10.7717/peerj.17793

[3] Karnik AP, Chhajer H, Venkatesh SB. Transforming Prosthodontics and oral implantology using robotics and artificial intelligence. *Front Oral Health*. 2024;5:1442100. Published 2024 Jul 29. doi:10.3389/froh.2024.1442100

[4] Bonny T, Al Nassan W, Obaideen K, Al Mallahi MN, Mohammad Y, El-Damanhoury HM. Contemporary Role and Applications of Artificial Intelligence in Dentistry. *F1000Res*. 2023;12:1179. Published 2023 Sep 20. doi:10.12688/f1000research.140204.1

[5] Wolfaardt JF, Brecht LE, Taft RM, Grant GT. The future of maxillofacial prosthodontics in North America: The role of advanced digital technology and artificial intelligence - A discussion document. *J Prosthet Dent*. 2024;131(6):1253.e1-1253.e34. doi:10.1016/j.prosdent.2024.03.016

[6] Schwendicke F, Mohammad Rahimi H, Tichy A. Artificial Intelligence in Prosthodontics. *Dent Clin North Am*. 2025;69(2):315-326. doi:10.1016/j.cden.2024.11.009

[7] Rasaie V, Abduo J. Current techniques for digital complete denture fabrication. *Int J Comput Dent*. 2022;25(2):181-199.

[8] Grande F, Pavone L, Molinelli F, Mussano F, Srinivasan M, Catapano S. CAD-CAM complete digital dentures: An improved clinical and laboratory workflow. *J Prosthet Dent*. Published online December 28, 2024. doi:10.1016/j.prosdent.2024.11.016

[9] Lo Russo L, Salamini A, Troiano G, Guida L. Digital dentures: A protocol based on intraoral scans. *J Prosthet Dent*. 2021;125(4):597-602. doi:10.1016/j.prosdent.2020.02.006

[10] Orgev A, Lin WS, Morton D. Digital Gothic Arch Tracing Device with Open- Source Software for CAD/CAM Denture Fabrication. *Int J Prosthodont*. 2024;37(1):103-108. doi:10.11607/ijp.8251

[11] Kaufman Z, Paranhos KS, de Carle LF, Kang M. Combining Digital Technology and Traditional Principles to Optimize Complete Removable Denture Treatment. *Compend Contin Educ Dent*. 2025;46(3):140-145.

[12] Cabrera IA, Pike TC, McKittrick JM, Meyers MA, Rao RR, Lin AY. Digital healthcare technologies: Modern tools to transform prosthetic care. *Expert Rev Med Devices*. 2021;18(sup1):129-144. doi:10.1080/17434440.2021.1991309

[13] Hassan M, Kushniruk A, Borycki E. Barriers to and Facilitators of Artificial Intelligence Adoption in Health Care: Scoping Review. *JMIR Hum Factors*. 2024;11:e48633. Published 2024 Aug 29. doi:10.2196/48633

[14] Aldhahi MI, Alorainy AI, Abuzaid MM, et al. Adoption of Artificial Intelligence in Rehabilitation: Perceptions, Knowledge, and Challenges Among Healthcare Providers. *Healthcare (Basel)*. 2025;13(4):350. Published 2025 Feb 7. doi:10.3390/healthcare13040350

[15] Hogg HDJ, Al-Zubaidy M; Technology Enhanced Macular Services Study Reference Group, et al. Stakeholder Perspectives of Clinical Artificial Intelligence Implementation: Systematic Review of Qualitative Evidence. *J Med Internet Res*. 2023;25:e39742. Published 2023 Jan 10. doi:10.2196/39742

[16] Al Hendi KD, Alyami MH, Alkahtany M, Dwivedi A, Alsaqour HG. Artificial intelligence in prosthodontics. *Bioinformation*. 2024;20(3):238-242. Published 2024 Mar 31. doi:10.6026/973206300200238

[17] Ahmed N, Abbasi MS, Zuberi F, et al. Artificial Intelligence Techniques: Analysis, Application, and Outcome in Dentistry-A Systematic Review. *Biomed Res Int*. 2021;2021:9751564. Published 2021 Jun 22. doi:10.1155/2021/9751564

[18] Revilla-León M, Gómez-Polo M, Vyas S, et al. Artificial intelligence applications in implant dentistry: A systematic review. *J Prosthet Dent*. 2023;129(2):293-300. doi:10.1016/j.prosdent.2021.05.008

[19] Revilla-León M, Gómez-Polo M, Vyas S, et al. Artificial intelligence applications in restorative dentistry: A systematic review. *J Prosthet Dent*. 2022;128(5):867-875. doi:10.1016/j.prosdent.2021.02.010

[20] Vishwanathaiah S, Fageeh HN, Khanagar SB, Maganur PC. Artificial Intelligence Its Uses and Application in Pediatric Dentistry: A Review. *Biomedicines*. 2023;11(3):788. Published 2023 Mar 5. doi:10.3390/biomedicines11030788

[21] Khanagar SB, Al-Ehaideb A, Maganur PC, et al. Developments, application, and performance of artificial intelligence in dentistry - A systematic review. *J Dent Sci*. 2021;16(1):508-522. doi:10.1016/j.jds.2020.06.019

[22] Carrillo-Perez F, Pecho OE, Morales JC, et al. Applications of artificial intelligence in dentistry: A comprehensive review. *J Esthet Restor Dent*. 2022;34(1):259-280. doi:10.1111/jerd.12844

[23] Mörch CM, Atsu S, Cai W, et al. Artificial Intelligence and Ethics in Dentistry: A Scoping Review. *J Dent Res*. 2021;100(13):1452-1460. doi:10.1177/00220345211013808

[24] Karobari MI, Adil AH, Basheer SN, et al. Evaluation of the Diagnostic and Prognostic Accuracy of Artificial Intelligence in Endodontic Dentistry: A Comprehensive Review of Literature. *Comput Math Methods Med*. 2023;2023:7049360. Published 2023 Jan 31. doi:10.1155/2023/7049360

[25] Tabatabaian F, Vora SR, Mirabbasi S. Applications, functions, and accuracy of artificial intelligence in

restorative dentistry: A literature review. *J Esthet Restor Dent*. 2023;35(6):842-859. doi:10.1111/jerd.13079

[26] Ding H, Wu J, Zhao W, Matinlinna JP, Burrow MF, Tsoi JKH. Artificial intelligence in dentistry-A review. *Front Dent Med*. 2023;4:1085251. Published 2023 Feb 20. doi:10.3389/fdmed.2023.1085251

[27] Chan H, Alimujiang A, Fong SI, et al. Use of T-Scan III in analyzing occlusal changes in molar fixed denture placement. *BMC Oral Health*. 2024;24(1):264. Published 2024 Feb 22. doi:10.1186/s12903-024-04014-1

[28] Liu J, Zhang C, Shan Z. Application of Artificial Intelligence in Orthodontics: Current State and Future Perspectives. *Healthcare (Basel)*. 2023;11(20):2760. Published 2023 Oct 18. doi:10.3390/healthcare11202760

[29] Bessadet M, Auduc C, Drancourt N, Nicolas E, El Osta N. Comparative analyses of time efficiency and cost in fabricating fixed implant-supported prostheses in digital, hybrid, and conventional workflows: A systematic review and meta-analysis. *J Prosthet Dent*. 2025;133(3):689-712. doi:10.1016/j.prosdent.2024.06.024

[30] Chopra S, Emran TB. Advances in AI-based prosthetics development: editorial. *Int J Surg*. 2024;110(8):4538-4542. Published 2024 Aug 1. doi:10.1097/JS9.0000000000001573

[31] Alowais SA, Alghamdi SS, Alsuhebany N, et al. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ*. 2023;23(1):689. Published 2023 Sep 22. doi:10.1186/s12909-023-04698-z

[32] Reddy S. Generative AI in healthcare: an implementation science informed translational path on application, integration and governance. *Implement Sci*. 2024;19(1):27. Published 2024 Mar 15. doi:10.1186/s13012-024-01357-9

[33] Beger J. The crucial role of explainability in healthcare AI. *Eur J Radiol*. 2024;176:111507. doi:10.1016/j.ejrad.2024.111507

[34] Awawdeh M, Alotaibi MB, Alharbi AH, Alnafisah SA, Alasiri TS, Alrashidi NI. A Systematic Review of Patient Satisfaction With Removable Partial Dentures (RPDs). *Cureus*. 2024;16(1):e51793. Published 2024 Jan 7. doi:10.7759/cureus.51793

[35] Zupancic Cepic L, Gruber R, Eder J, Vaskovich T, Schmid-Schwap M, Kundi M. Digital versus Conventional Dentures: A Prospective, Randomized Cross-Over Study on Clinical Efficiency and Patient Satisfaction. *J Clin Med*. 2023;12(2):434. Published 2023 Jan 5. doi:10.3390/jcm12020434

[36] Alyami MH. The Applications of 3D-Printing Technology in Prosthodontics: A Review of the Current Literature. *Cureus*. 2024;16(9):e68501. Published 2024 Sep 3. doi:10.7759/cureus.68501

[37] Ahmed MI, Spooner B, Isherwood J, Lane M, Orrock E, Dennison A. A Systematic Review of the Barriers to the Implementation of Artificial Intelligence in Healthcare. *Cureus*. 2023;15(10):e46454. Published 2023 Oct 4. doi:10.7759/cureus.46454

[38] Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. *Future Healthc J*. 2021;8(2):e188-e194. doi:10.7861/fhj.2021-0095

[39] Farhadi Nia M, Ahmadi M, Irankhah E. Transforming dental diagnostics with artificial intelligence: advanced integration of ChatGPT and large language models for patient care. *Front Dent Med*. 2025;5:1456208. Published 2025 Jan 6. doi:10.3389/fdmed.2024.1456208

[40] Al Kuwaiti A, Nazer K, Al-Reedy A, et al. A Review of the Role of Artificial Intelligence in Healthcare. *J Pers Med*. 2023;13(6):951. Published 2023 Jun 5. doi:10.3390/jpm13060951