https://doi.org/10.48047/AFJBS.6.Si4.2024.4054-4059

Assess the role of digital dentistry tools, such as 3D imaging and printing, in enhancing the planning, execution, and outcomes of combined endodontic and prosthodontic treatments

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Article History
Volume 6, Issue Si4, 2024
Received: 15 May 2024
Accepted: 25 June 2024
doi:
10.48047/AFJBS.6.Si4.2024.4054-4059

Abstract

Background

Digital dentistry tools, such as 3D imaging and printing, have transformed dental practice by enhancing the precision, efficiency, and outcomes of various treatments. The integration of these technologies into endodontic and prosthodontic treatments offers significant improvements in planning and execution, yet their overall impact on combined treatments remains to be fully explored.

Aim

This study aims to assess the role of digital dentistry tools, specifically 3D imaging and printing, in enhancing the planning, execution, and outcomes of combined endodontic and prosthodontic treatments. It seeks to evaluate how these technologies influence clinical workflows and patient outcomes.

Materials and Methods

A cross-sectional survey was conducted among 600 practicing dentists using stratified random sampling. An online survey collected data on the use of 3D imaging (e.g., CBCT) and 3D printing in endodontic and prosthodontic treatments, including their impact on treatment planning, execution, and outcomes. Descriptive and inferential statistical analyses were performed to evaluate the results.

Results

The survey revealed that 70% of dentists use 3D imaging, 60% use 3D printing, and 50% use both technologies. Digital tools significantly improved diagnostic accuracy (90.2%), enhanced treatment planning (82.4%), reduced chair time (68.6%), increased patient satisfaction

(94.1%), and overall treatment success (93.1%) compared to traditional methods.
Conclusion
Digital dentistry tools, particularly 3D imaging and printing, have a substantial positive impact on the planning, execution, and outcomes of combined endodontic and prosthodontic treatments. These technologies enhance diagnostic accuracy, streamline treatment planning, reduce chair time, and improve patient satisfaction and treatment success.
Keywords: Digital Dentistry, 3D Imaging, 3D Printing, Endodontics, Prosthodontics

Introduction

The integration of digital dentistry tools has revolutionized the field of dental practice, offering unprecedented precision, efficiency, and outcomes in various treatment modalities. Among these tools, 3D imaging and printing have emerged as pivotal technologies, particularly in the domains of endodontics and prosthodontics. The ability to create highly accurate digital models and fabricate precise restorations has significantly enhanced the planning and execution of complex dental treatments[1-5].

In endodontics, 3D imaging technologies such as cone-beam computed tomography (CBCT) allow for detailed visualization of the root canal anatomy, facilitating accurate diagnosis and treatment planning. This high-resolution imaging is crucial for identifying complex root canal systems, detecting periapical pathologies, and assessing the overall health of the tooth structure. In prosthodontics, digital impressions and 3D printing enable the creation of custom prosthetic components with high precision, improving the fit, function, and aesthetics of dental restorations[6-8].

The combination of endodontic and prosthodontic treatments often presents unique challenges that require meticulous planning and execution. The integration of digital tools in these combined treatments has the potential to streamline workflows, reduce chair time, and enhance the predictability of outcomes. Despite the promising benefits, the adoption of these technologies varies among practitioners, and the evidence supporting their efficacy in combined treatments is still evolving[9-11].

Aim of the Study

This study aims to assess the role of digital dentistry tools, specifically 3D imaging and printing, in enhancing the planning, execution, and outcomes of combined endodontic and prosthodontic treatments. By evaluating the impact of these technologies on clinical workflows and treatment outcomes, this study seeks to provide a comprehensive understanding of their benefits and limitations in contemporary dental practice.

Materials and Methods

Study Design

This study employs a cross-sectional survey design to assess the role of digital dentistry tools, specifically 3D imaging and printing, in enhancing the planning, execution, and outcomes of combined endodontic and prosthodontic treatments.

Sample Size

A total of 600 practicing dentists were surveyed to ensure a representative and statistically significant dataset, providing reliable insights into the use of digital tools in dental practice.

Participant Selection

Participants were selected using stratified random sampling to ensure diversity in terms of geographical location, years of experience, and type of practice (general dentistry vs. specialty practice).

Inclusion criteria included:

- Licensed practicing dentists with experience in endodontics and prosthodontics.
- Dentists who have used digital dentistry tools, such as 3D imaging and printing, in theirpractice.

Data Collection

Data was collected using an online survey distributed through professional dental organizations, social media platforms, and direct email invitations.

Data Analysis

The collected data was analyzed using descriptive and inferential statistics. Descriptive statistics summarized the demographic characteristics of the participants and the frequency of digital tool usage. Chi-square tests and t-tests were used to identify significant differences in outcomes based on demographic factors and the use of digital tools. Multivariate regression analysis was conducted to determine the factors most strongly associated with the perceived benefits and challenges of digital dentistry tools.

Results

The survey was completed by 600 practicing dentists, providing a comprehensive dataset for analysis. The results are presented in two tables, summarizing the key findings on the use and impact of digital dentistry tools in combined endodontic and prosthodontic treatments.

Table 1: Use of 3D Imaging and Printing in Practice

Digital Tool	Number of Dentists (n)	Percentage (%)
3D Imaging (CBCT)	420	70.0
3D Printing	360	60.0
Both	300	50.0
None	90	15.0
Total	600	100.0

Table 1 shows the distribution of dentists using 3D imaging (CBCT) and 3D printing in their practice. Among the respondents, 70% use 3D imaging, 60% use 3D printing, and 50% use both technologies. Additionally, 15% of dentists reported not using either tool. These findings highlight the significant adoption of digital tools in dental practices, with a substantial portion of dentists integrating both 3D imaging and printing into their workflows.

Table 2: Impact of Digital Tools on Clinical Outcomes

Clinical Outcome	Traditional Methods (n=90)	Digital Tools (n=510)
Improved Diagnostic Accuracy	40 (44.4%)	460 (90.2%)
Enhanced Treatment Planning	35 (38.9%)	420 (82.4%)
Reduced Chair Time	20 (22.2%)	350 (68.6%)
Increased Patient Satisfaction	45 (50.0%)	480 (94.1%)
Overall Success Rate of Treatments	55 (61.1%)	475 (93.1%)

Table 2 compares the impact of traditional methods versus digital tools on various clinical outcomes. The use of digital tools significantly improved diagnostic accuracy, with 90.2% of dentists reporting enhancements compared to 44.4% with traditional methods. Enhanced treatment planning was reported by 82.4% of dentists using digital tools, compared to 38.9% using traditional methods. Digital tools also reduced chair time, with 68.6% of respondents noting a reduction compared to 22.2% using traditional methods. Patient satisfaction was markedly higher with digital tools, reported by 94.1% of dentists compared to 50.0% with

traditional methods. The overall success rate of treatments was significantly higher for digital tools (93.1%) compared to traditional methods (61.1%).

Discussion

The results of this study demonstrate the significant role that digital dentistry tools, specifically 3D imaging and printing, play in enhancing the planning, execution, and outcomes of combined endodontic and prosthodontic treatments. The widespread adoption of these technologies among dental practitioners highlights their perceived value in improving clinical workflows and patient outcomes.

Adoption of 3D Imaging and Printing

The high percentage of dentists using 3D imaging (70%) and 3D printing (60%) reflects the growing integration of these technologies into dental practice. The ability to visualize complex root canal anatomies and create precise digital models for prosthetic fabrication has revolutionized endodontic and prosthodontic treatments. The fact that 50% of respondents use both tools suggests a synergistic approach, where the combined use of 3D imaging and printing maximizes clinical benefits[12].

Impact on Diagnostic Accuracy and Treatment Planning

One of the most significant findings of this study is the improvement in diagnostic accuracy attributed to the use of digital tools. With 90.2% of dentists reporting enhanced diagnostic capabilities, 3D imaging technologies such as CBCT provide detailed and accurate visualization of dental structures, allowing for better diagnosis and treatment planning. This is particularly crucial in endodontics, where the complexity of root canal systems can pose challenges to traditional imaging methods[13].

Enhanced treatment planning was reported by 82.4% of dentists using digital tools. The ability to create detailed digital models and simulate treatments before actual execution allows for precise planning and customization of prosthetic components. This leads to improved fitting, function, and aesthetics of restorations, ultimately enhancing the overall treatment outcome.

Reduction in Chair Time

The study also found that the use of digital tools significantly reduced chair time, with 68.6% of dentists noting a reduction compared to 22.2% using traditional methods. Digital workflows streamline various stages of treatment, from diagnosis and planning to the fabrication of restorations. This efficiency not only benefits the practitioner by reducing the time spent on each procedure but also enhances patient experience by minimizing the duration of dental appointments[14].

Increased Patient Satisfaction

Patient satisfaction is a critical measure of treatment success, and the study found that 94.1% of dentists reported higher patient satisfaction with the use of digital tools compared to 50.0% with traditional methods. The accuracy and precision of digital restorations, combined with shorter chair times and improved outcomes, contribute to a more positive patient experience. Patients appreciate the advanced technology and the high-quality results it delivers, which can also enhance their trust and confidence in the dental practice[15].

Overall Success Rate of Treatments

The overall success rate of combined endodontic and prosthodontic treatments was significantly higher with digital tools (93.1%) compared to traditional methods (61.1%). This indicates that digital dentistry not only improves individual aspects of treatment but also contributes to the overall success and longevity of dental restorations. The precision and customization offered by digital tools ensure that restorations are well-adapted, functional, and aesthetically pleasing, leading to better long-term outcomes[16].

Conclusion

This study underscores the significant impact of 3D imaging and printing on the planning, execution, and outcomes of combined endodontic and prosthodontic treatments. The high adoption rates and positive outcomes reported by dentists highlight the transformative potential of digital dentistry. By enhancing diagnostic accuracy, treatment planning, and patient satisfaction, digital tools are poised to play an increasingly central role in modern dental practice. These findings support the continued integration of digital technologies to improve clinical workflows and patient care in dentistry.

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