

THE ROLE OF TELEDENTISTRY IN ENHANCING DIAGNOSIS, CONSULTATION, AND POST-OPERATIVE CARE IN RESTORATIVE DENTISTRY: A REVIEW ARTICLE

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ABSTRACT

Within the current digital advancement of the dental field in all aspects, teledentistry has become one of the essential tools that enables fast and accurate diagnosis, and thus high-quality treatment and improved outcomes. This review explores the role of teledentistry in improving diagnosis, consultation and post operative management of the different dental restorative specialties. It was conducted using PubMed, Scopus, and Google Scholar databases. Recent estimates indicate that over 63% of the global population actively uses the internet. It was found that teledentistry gives the advantage to the underserved rural areas to access advanced consultation and diagnosis from specialized health care providers. Consultations and teledentistry assessments were found to achieve comparable diagnostic accuracy rates to in-person evaluations of up to 85%. The findings showed that the use of teledentistry reduces patient waiting times, referral rates, and in-office waiting times, while maintain a high patient satisfaction. Additionally, it offers access to expert opinions within specialized fields and proves invaluable for remote patient management and monitoring, although some challenges associated with teledentistry stem from technical issues. In conclusion, teledentistry significantly enhances overall diagnosis, management, outcomes, and the patient experience. However, further improvements are still needed.

Keywords: teledentistry, teleconsultation, restorative dentistry

INTRODUCTION

Teledentistry is the use of telemedicine technologies, which is allowing remote diagnosis in dental care and advice for the management of dental cases (1). It allows dental professionals to communicate with patients and other clinicians, and to share documents via video conferencing and other online platforms to overcome geographical barriers (2). Studies have shown that a growing number of people are using teledentistry to provide patients with better access to specialist care, particularly in impoverished and rural areas (3). Teledentistry enhances clinical decision making by enabling real-time collaboration between general dentists

and specialists to reduce treatment delays (4).

Recently, it has been observed that the implementation of photography has been increased in restorative dentistry. However, it has not been widely used for diagnosis, consultations, and referrals. It has been reported that the diagnosis of dental caries using photography is nearly similar to the traditional method in the clinic (5). In restorative dentistry, several studies have claimed that the photographic data obtained by intraoral cameras is a valid method to evaluate dental restorations, oral soft tissues, or dental prosthetic appliances (6-8).

The widespread adoption of smartphones and software technologies

has led to another level of clinical data transmission between patients and health providers. Nearly, all smartphones are equipped with cameras and communication functions with affordable costs, which can be applied as a proper tool in teledentistry. Some studies have compared the obtained photographs of smartphones to in-person examination in dental clinics and revealed comparable outcomes (6,9).

Initially, teledentistry in restorative dentistry was a subset of more general telemedicine developments meant to alleviate regional and specialty shortages in dental care. The growing demand for treatment planning and remote consultations, particularly in underserved or rural areas, drove its evolution. Early investigations focused on feasibility using platforms for transmitting digital radiographs and patient records. The use of teletechnology applications have surged tremendously during COVID-19 pandemic. It has been reported that high-resolution imaging such as digital radiographs can be transmitted remotely for expert interpretation for diagnosis (9). It appears that this process helps patients to receive proper diagnosis without the need to travel for long distances. Patients and specialists can connect in real time through teleconsultations to plan treatments faster, and handle problems before performing operations in the clinic. In addition, remote follow-up consultations help patients to receive better post-operative care as they may require a smaller number of clinical visits and can report symptoms remotely to receive professional recommendations. These features could help patients and doctors to minimize the expenses and

treatment durations while keeping the standard quality of diagnosis and assessments (10).

Rationale

Studies have investigated and reported favorable findings about the use of digital cameras in detecting caries, defective restorations, cracked teeth, periodontal conditions, and treatment planning for endodontics and prosthodontics cases (11-15). Moreover, it has been shown that combining advanced imaging with live patient connection may help physicians to make better diagnosis and provide faster medical attention which could lead to better treatment outcomes (11). Virtual post-operative care has been claimed to allow patients avoiding multiple office visits while maintaining control over their recovery (2). Teledentistry position in restorative dentistry is expected to grow as it develops further, providing an appropriate solution to the problems with the current delivery of dental healthcare (16). Through telemedicine technologies, teledentistry is assumed to help patients in remote areas to receive better dental care from specialists. Therefore, this review aims to explore teledentistry as a useful tool in different aspects of restorative dentistry.

1. SEARCH STRATEGY

This review was conducted using PubMed, Scopus, and Google Scholar databases to identify relevant published studies on teledentistry and its applications in restorative dentistry. Various keyword combinations of *teledentistry*, *restorative dentistry*, *operative*, *endodontics*, *periodontics*, and

prosthodontics were used. Peer-reviewed articles published in English were included based on their focus on teledentistry and technological advancements in restorative dentistry and their clinical applications.

2. CURRENT PERSPECTIVES

Improved Diagnosis Through Remote Imaging and Assessment

Teledentistry enables general dentists to improve diagnosis through online image sharing and digital assessments with specialists. There are various medical facilities that offer advanced imaging options such as cone-beam computed tomography (CBCT) and digital radiographs. The obtained images can be securely stored and shared electronically by clinicians and patients. It has been demonstrated that these tools can be utilized in teledentistry and help healthcare providers for early and precise detection of dental problems while obtaining second opinions for complex cases. For instance, CBCT is a reliable imaging method for identifying root fractures and complex root canals, as well as for assessing bone levels and density in periodontics and prosthodontics treatment planning (17-19).

A 2008 study assessed the effectiveness of CBCT in identifying root canal systems (RCSs) in extracted teeth, comparing it to conventional radiographic methods (20). It was found that endodontists using charge coupled device (CCD) and photostimulable phosphor plate (PSP) imaging missed at least one RCS in approximately 40% of cases, whereas CBCT provided a clearer and more accurate identification. The study concluded that CBCT is a valid tool

that improves diagnostic accuracy and therefore enhances endodontic treatment outcomes.

In the field of periodontics, studies have found that teledentistry is also an effective tool that enhances patients' education, early diagnosis, and remote monitoring of periodontal health (21). It allows periodontists to perform assessments to gingival inflammation, plaque accumulation, and potential periodontal pockets remotely. As a result, improved diagnosis through remote imaging and assessment has significantly improved patient care. It has been found that using teledentistry for remote evaluation of periodontal conditions, such as probing depths and gingival recession, are comparable to in-person assessments (7). This can be performed by reviewing high-resolution images and patient data, which ensure precise diagnosis using teledentistry. A review study emphasized that remote imaging and consultations enable ongoing monitoring of treatment progress for periodontal cases and facilitate quicker interventions when necessary (8).

In prosthodontics, teledentistry can be used in treatment planning, follow-up care, and sharing digital documents. The recent advances of intraoral scanning and digital impression technologies enable prosthodontists to properly perform the diagnostic phase remotely (22). This could be beneficial to evaluate occlusion, teeth morphology, and the health of the soft tissues without the need for a physical visit. Some studies have demonstrated that teledentistry allowed prosthodontists to conduct accurate remote assessments for patients requiring crowns, bridges, or dentures (23). It was found that sharing digital

images and patients' data remotely allow specialists to reach proper diagnoses and treatment options without the need for patients to travel to specialty clinics.

This experience may not only facilitate sharing data and performing virtual communications, but it could also improve the diagnostic process in shorter time. In case of access to specialty care is limited such as rural areas, it has been indicated that teledentistry works efficiently among local general dentists to collaborate with specialists, thereby improving the diagnoses and assessments of patients' conditions (24,25). Real-time video meetings also allow for interactive discussions between the dentist and patient, further enhancing diagnostic precision. By discussing symptoms and reviewing images together, patients gain a better understanding of their diseases and available treatments. This instant feedback loop minimizes treatment delays, which is crucial for managing urgent conditions in restorative dentistry that require prompt attention.

Remote Consultations for Pre-Treatment Planning and Post-Operative Care

Remote consultation has become an integral component of pre-treatment planning in restorative dentistry. It enables dentists to assess dental conditions, discuss treatment options, and coordinate for treatment plans before an in-office visit. Regarding operative dentistry, some studies have indicated that remote consultation is a valid option (5,6). It was found that dentists can assess caries risk, discuss minimally invasive treatment options, and provide some preventive strategies prior to the in-office procedures (1). In addition, it is easier to

share intraoral images and radiographs between patients and clinicians, which therefore lead to efficient treatment planning.

In endodontics, the consultation process involves multiple steps, from patient evaluation to determining the most appropriate treatment plan. Teledentistry has significantly expedited this process by offering secure video consultations and online platforms. Thus, patients can communicate with dentists about their symptoms and share medical history remotely. It has been indicated that this approach saves time and reduces unnecessary visits, which is especially beneficial for patients with mobility issues or who live far from endodontic specialists (24). Patients having complex cases such as apical periodontitis, could consult with an endodontist online and share their imaging results, and receive expert recommendations without needing an in-person visit. This strategy will not only reduce the strain on healthcare resources but provide timely intervention.

In periodontics, teledentistry supports the early diagnosis of periodontal diseases by enabling remote assessment of clinical parameters such as gingival inflammation, recession, and attachment loss (26). Periodontists can guide patients on initial management strategies as improved oral hygiene and antimicrobial therapy. This can be performed before scheduling in-office treatments such as scaling and root planning. Therefore, this process could reduce unnecessary visits and ensures that patients receive proper treatment at the right time.

Regarding prosthodontics, it has been found that virtual consultations

facilitate the planning for the different prosthetic treatments such as crowns, bridges, and implant-supported prostheses. The use of digital impressions, 3-dimensional scans (3D), and occlusal analysis software programs allow specialists to evaluate various parameters remotely (15,19,23). Therefore, remote consultations can assist in pre-treatment evaluations, such as assessing occlusion and planning implant placements. In addition, prosthodontists can collaborate with dental technicians and other specialists to refine treatment plans before physical appointments, which can improve accuracy and reduce chairside time (27).

For referring general dentists, teleconsultation offers the opportunity to collaborate with multiple specialists, ensuring that complex cases are handled with the most effective treatment plans (4,24,26). In addition to saving time, teledentistry has been claimed to improve the quality of care by maintaining constant contact between patients and clinicians. Patients can ask questions and seek clarification remotely, which eventually lead to an improved treatment outcome. For instance, if a patient is required to follow specific instructions prior to a root canal procedure, teleconsultation enables clear discussion of these details, while minimizing the risk of complications arising from miscommunication (28,29).

The current advancements in teledentistry appear to be very useful in remote consultations and pre-treatment planning. This is because teledentistry is featured with secure cloud-based electronic health records (EHRs) and artificial intelligence powered (AI-powered) diagnostics. Healthcare

providers can now analyze complete patient information including medical images and records from anywhere. AI is being frequently used in predictive analytics and for guiding decisions on the most appropriate treatment modalities based on historical data and risk factors. It has been suggested that remote consultations help clinicians plan treatments more efficiently. Studies have shown that store-and-forward technologies in teledentistry, for example, reduce time of treatment decisions by allowing specialists to review diagnostic data asynchronously (30). Real-time discussions between healthcare teams enhance interdisciplinary collaboration that would lead to more personalized patient care. However, there are still some challenges as data security, confidentiality, and the need for standardized protocols. As 5G networks expand and encryption technology advances, remote pre-treatment consultations will become an integral part of modern dental practice (31).

AI technology enhances teledentistry by improving procedural workflows, which may aid in treatment planning and enhancing diagnostic accuracy in restorative dentistry specialties. CBCT scans and other complex imaging data are useful tools that help in providing better and accurate diagnosis. In endodontics, AI systems assist in automating root canal segmentation, which can lead to faster and more precise procedures. Also, it provides real-time feedback for clinicians, which minimizes procedural errors and optimizes patient outcomes. Similarly, in prosthodontics, it has been found that inadequate initial planning or

improper occlusal adjustments could lead to long-term complications, thus the implementation of AI reduces these issues (32). In periodontics, AI-assisted teleconsultations facilitate early detection of periodontal pathology and provide remote guidance on pre-surgical protocols, such as adjusting anticoagulant medications or addressing dental anxiety (33). This emphasizes the importance of AI-assisted precision in restorative workflows. Therefore, integrating AI into teledentistry facilitates better decision-making, enhances procedural efficiency, and improves overall patient care (30,34,35). Besides, it has been demonstrated that teledentistry consultations significantly reduce pre-treatment wait times (21,27).

The success of restorative dental treatments depends on effective post-operative care. Teledentistry enables efficient recovery monitoring, which allows clinicians to address complications remotely and reduces unnecessary in-person visits. Studies have indicated that post-operative teleconsultations eliminate most of unnecessary follow-up appointments, with most concerns being managed virtually (2,11). Additionally, teledentistry enhances patient adherence to care instructions, improving treatment success rates by nearly 15%, particularly following procedures such as root canal therapy, periodontal surgeries, and prosthodontic rehabilitations (35,36).

Telehealth Adoption and Usage Among Physicians

According to the 2021 American Medical Association (AMA) survey, 85% of physicians utilize telehealth, with video consultations comprising 93% of

virtual appointments and audio-only calls accounting for 69% (37). While 76% of physicians manually communicate patient data, only 8% incorporate remote monitoring tools. Despite 52% reporting decreased telehealth usage due to technological constraints and patient preferences for in-person visits, 60% believe telehealth supports high-quality care. It was found that telehealth is recognized for improving patient access (80%) and enhancing patient satisfaction (62%). Physicians express mixed views, with 54.2% reporting increased professional satisfaction. Utilization varies, with 46.8% of physicians conducting fewer than 10% of their weekly visits virtually, while 30.6% report a higher proportion. Among healthcare practices, 37% report successful telehealth implementation, while 69% continue refining their systems. Future telehealth developments will emphasize specialty care, mental health, and chronic disease management. Notably, 35.5% of healthcare leaders aim to expand telehealth services. Within dentistry, teledentistry accordingly can play a crucial role in delivering specialized care to underserved communities, where limited access to specialists exacerbates treatment delays and oral health disparities.

DISCUSSION

Teledentistry has become one of the essential tools that allows accurate diagnosis, and thus high-quality treatment and outcome. It has been shown that teledentistry is a reliable and effective method for diagnosis in all different restorative specialities, which are operative, endodontics, periodontics, and prosthodontics. A systematic review

by Niknam et al. (2023) analysed 19 studies, reporting sensitivity between 48% and 98.3% and specificity from 83% to 100% for caries diagnosis using teledentistry (13). These findings suggest that teledentistry, particularly through mobile devices, is a reliable alternative to traditional examinations, which makes it especially beneficial in underserved areas (38). Ashtiani et al. (2024) further supported this by demonstrating that mobile phone photographs taken by community health workers achieved sensitivity exceeding 80% and specificity over 90% for caries detection in children (39). This highlights a cost-effective approach to dental care in lower-middle-income countries. A comprehensive evaluation by Kargozar and Jadidfar (2024) assessed extraoral photography in teledentistry, which compared a digital camera (Digital Single-Lens Reflex (DSLR)) and smartphone images with traditional examinations. Based on study design and diagnostic criteria, it was found that the sensitivity varied between 48% and 98.3%, and specificity ranged from 83% to 100% (40). Even though teledentistry has been proven as an effective method for diagnosing dental caries, some studies have emphasized the need for larger and more reliable investigations. Regarding endodontics, teledentistry allows endodontists to evaluate cases remotely through video conferencing, shared patient information, radiographs, and CBCT scans. This system enables precise diagnosis without in-person consultations. It appears that the real-time communication tools facilitate collaboration between general dentists and specialists. This helps in expedites decision-making for complex

cases and improves patient outcomes (41).

The recent technological advances in the dental field offer improved innovations. High-end equipment, such as intraoral scanners, high-definition cameras, and secure data-sharing software, is essential for teledentistry. One notable innovation is the intraoral 3D scanner, which produces highly accurate digital impressions of teeth. These compact and lightweight scanners are now widely used in dental clinics, laboratories, and private practices. Moreover, Bluetooth integrated smart toothbrushes have been developed, which allow users to monitor and improve their oral hygiene habits. The growing adoption of these technologies reflects their value in enhancing patient care. The involvement of other transformative technologies, such as dental 3D printers, intraoral cameras, and augmented reality (AR), is reshaping dental procedures. Currently, AR supports dental diagnostics but is expected to expand its applications in treatment planning and education. Teledentistry is increasingly being integrated with laser dentistry, virtual reality (VR), and AI-powered diagnostics (30).

Furthermore, AI can be used to assist in refining diagnostic accuracy. However, stringent data protection protocols must be followed, as telemedicine platforms require robust encryption systems (42). To use these tools effectively, dental professionals must receive specialized training and engage in continuous professional development to stay updated on technological advancements. AI accelerates the detection and assessment

of dental conditions, while teledentistry reduces clinic wait times and improves access to care in remote areas. As teledentistry continues to evolve, its integration with restorative dental specialties will further enhance patient outcomes, improve accessibility, and streamline treatment workflows.

Teledentistry employs encrypted telemedicine systems to protect patient data. These legal frameworks dictate secure handling of sensitive information. This is also effective for post-operative care that allow clinicians to monitor recovery remotely. Video follow-ups provide real-time assessments of symptoms such as pain and swelling, which reduce the need for in-office visits. Moreover, it appears that complications can be managed through remote consultations, which ensures timely and appropriate care. Digital platforms offering post-operative instructions have also improved patient adherence to treatment protocols (43).

Research supports that teledentistry can successfully manage complex cases, providing timely and accurate care from consultation through post-operative follow-ups (44). Comparative studies indicate that patient outcomes are similar between teledentistry-assisted and in-person restorative treatments, positioning teledentistry as viable and convenient alternative. However, its value should be assessed using clinical outcomes, physician feedback, patient satisfaction

metrics, and healthcare accessibility. It is expected that patient and provider satisfaction with teledentistry remains high, which is driven by the efficiency and accessibility of virtual care. Despite its benefits, teledentistry still faces challenges such as managing complex cases remotely, ensuring accurate diagnoses without performing physical examinations, and complying with regional legal and ethical guidelines. In addition, it has been reported that poor internet connectivity and limited technological resources can also affect the quality of virtual consultations (45). Therefore, maintaining patients' trust in online care remains a key challenge.

CONCLUSIONS

Teledentistry helps specialists in restorative dentistry to improve diagnosis quality, consultations and post-treatment care. Both patients and healthcare providers are benefited from remote imaging tools, virtual consultations, and online group meetings. The adoption of teledentistry technologies allows specialists to optimize treatment outcomes and deliver efficient care. Although, there are some challenges related to technology infrastructure and patient trust, teledentistry addresses the growing demand for specialty services by aligning with healthcare system objectives of improved accessibility and operational efficiency.

Disclosure

The author reports no conflicts of interest in this work.

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