

Modern Systems of Technology Used in Rapid Diagnosis of Oral and Dental Health and Their Clinical Uses in the Kingdom of Saudi Arabia

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Abstract

The rapid diagnosis of oral and dental health plays a crucial role in ensuring effective treatment and preventing the escalation of dental issues. This paper explores the modern technologies used in the rapid diagnosis of oral and dental conditions, including fluorescence imaging, laser-induced imaging, near-infrared imaging, smartphone-based imaging screening, multispectral and hyperspectral imaging, and electrochemical-based detection systems. These technologies enable accurate and timely diagnosis, enhancing the effectiveness of treatment plans and reducing healthcare costs. The study highlights the challenges faced by traditional diagnostic methods, including limited accuracy and subjective diagnosis, and underscores the importance of integrating modern diagnostic technologies into the dental healthcare system in the Kingdom of Saudi Arabia. The adoption of these technologies is expected to improve patient outcomes, streamline diagnostic procedures, and contribute to the overall improvement of oral health in the country.

Keywords: rapid diagnosis, oral health, dental health, fluorescence imaging, laser-induced imaging, near-infrared imaging, smartphone-based imaging, multispectral imaging, hyperspectral imaging, electrochemical detection, Saudi Arabia

1. Introduction

Accurate and rapid diagnosis forms the foundation of successful clinical treatment across all fields of health care. This is achieved through screening and in-depth diagnostic analysis of a health ailment to determine its health impact and identify potential treatment methods. In the case of oral and dental health, precise diagnosis of defects in the oral cavity and dental structure is critical for the general as well as preventive healthcare of an individual (S Almajed et al., 2024). A range of ailments such as dental cavities, plaque deposition, oral and dental lesions, and conditions regarding the health of the gums can lead to the escalation of oral and dental defects. Therefore, it becomes important to monitor the oral cavity and teeth on a routine basis. Timely and rapid diagnoses improve the degree of health treatment and enhance the outcomes of health recovery. Currently, a number of modern systems of technology are available that allow for the rapid diagnosis of the oral cavity and teeth. Some of the technologies use advanced systems of imaging, while others utilize the chemical sensing approach to examine the health conditions of the oral cavity and teeth. Also, a few health technologies employ a combination of advanced techniques to enhance the degree of health monitoring accuracy. Currently, the assessment of the health technologies used for the rapid detection of oral cavity and dental structure defects is low in the Kingdom of Saudi Arabia. This is critical since the integration of the modern systems of technology into the existing framework of health care can improve the degree of health treatment and avoid health deterioration due to neglected dental and oral defects. Therefore, it becomes necessary to examine the different modern systems of technology used for the rapid diagnosis of oral cavity and dental health along with their clinical uses in the perspectives of the Kingdom of Saudi Arabia. This essay discusses various systems of technology such as the use of fluorescence imaging, laser-induced imaging, and near-infrared imaging to visualize the hard tissues of the teeth, and smart phone-based imaging screening for the detection of dental caries, health monitoring tongue inspection system, multispectral and hyperspectral imaging systems, and electrochemical-based detection systems and their health monitoring approaches. (Alauddin et al., 2021)(Ilhan et al., 2021)(Awad et al.2021)

2. Overview of Oral and Dental Health in the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia (KSA) has made significant advancements in the education, legislation, and availability of professional dental care to its people over the past five decades. However, several complications still exist, as people often ignore the importance of oral hygiene and health. Consequently, various oral and dental disorders affect health immensely. Many health disorders arise due to dental disorders, affecting mental and social health, especially among the young and

adolescent populations (S Almajed et al., 2024). This narrative discusses an overview of current oral and dental health in the KSA, prevalent disorders, and the impact of oral health problems on overall health. Current and historical dental care, practices, types and prevalence of disorders, awareness among people, and the growth of the dental healthcare system are discussed. An insight into literacy about health, health standards, and government initiatives and policies is presented using the available data and statistics. Most dental disorders are prevalent among the young population. Though the rural population constitutes a small percentage of the total population, many progress and developmental challenges exist within the rural health and healthcare system. Access to dental care is complicated in rural areas since primary health care is not provided, and government dental health services are available only in urban areas. Regarding gender disparity in oral health awareness, females are more aware, but the overall percentage is less. Though efforts have been made to improve health standards, many upgrades are needed. The possible need for rapid diagnostic methods for oral health problems is highlighted. The kingdom has a broad population, area, and diverse environment. Urbanization and population growth posed enormous progress and developmental challenges for the health and healthcare system. Oral health is an integral part of health. Still, oral health problems have remained one of the most neglected health problems, particularly in developing and underdeveloped areas, even though the oral health care system is better than many other health care systems in the KSA. An insight into current oral and dental health problems, lifestyle, and the health care system is presented, focusing on the need for improved diagnostic technologies in the current health care system. (Chan et al.2021)(Malicka et al., 2022)(Wolf et al.2021)(John, 2021)

3. Importance of Rapid Diagnosis in Oral and Dental Health

The health and appearance of one's teeth and gums are important not only to maintain chewing efficiency but also to enhance one's sociality because they are outwardly disclosed during conversation and smiling. Thus, oral and dental health should be managed effectively. Rapid diagnosis of oral and dental health implicates the swift detection of dental health troubles such as the occurrence of dental caries, periodontitis, or the troubles pertaining to denture wear. Prompt and precise diagnosis of dental troubles can lead to the right treatment plan, which results in effective treatment. Moreover, patients will be more satisfied with the treatment plan and outcome when they are diagnosed rapidly (Radwan et al., 2020). In addition, early detection of dental troubles is essential from the viewpoint of treatment cost. Normally, simple and easy treatments can be applied for the early stage of dental troubles, whilst complicated and expensive treatments are required when the troubles progress. Therefore, systemic prevention care strategies are essential for the early detection of dental troubles. In general, dental health diagnosis is performed based on the observation of a dentist using the five senses as the principal means. Traditionally, the observation of teeth and gums is complemented with the aid of simple tools such as a dental mirror, probe, suction, and air spray. Moreover, in the past decade, advanced techniques have been developed in the shaping of dental health diagnosis. To prevent the progression of dental diseases, the conventional techniques for dental health diagnosis should be upgraded to ameliorate the precision, simplicity, and rapidity of diagnosis. Although the conventional techniques are effective in detecting dental troubles, they tend to miss the troubles at the initial stage. That is, a dental health trouble goes undetected until it progresses and necessitates an advanced treatment. There are also some other limitations. Because conventional techniques require meticulous observation, the diagnosis will be postponed when a dentist's workload increases. Moreover, the use of conventional techniques may provide a different diagnosis by different dentists due to their subjective nature. Thus, an alternative diagnostic approach is demanded. On the other hand, the modern systems of technology-based approaches may provide a fixed diagnosis regardless of who performs the diagnosis. Furthermore, once the technology is installed, the health diagnosis can be provided anywhere in the world, solving the issue of the scarcity of dentists in some regions. Moreover, a timely diagnosis can reduce the cost of health care spent on advanced treatment. The purpose is to provide an overview of the contemporary systems of technology used in rapid diagnosis of oral and dental health. The necessity of rapid diagnosis systems would be discussed along with the problems of current approaches.

3.1. Benefits of Early Detection

Early detection is crucial in the management of most diseases, including dental diseases. When diseases are detected on time, maximal benefit can be derived from treatment, and health outcomes are significantly improved. Various dental conditions, including caries, non-cavitated carious lesions, periodontal disease, gingivitis, fractured teeth, temporomandibular joint disorder, abscess, and oral cancer, can be detected early during routine dental check-ups (Radwan et al., 2020). Most dental diseases start off as mild and manageable conditions. With time, they develop into serious health issues that require extensive and complicated corrective procedures. For example, dental caries can be effectively reversed if the initial stages are detected when teeth have white spot lesions. Once cavitation occurs, only restoration is possible, and the tooth is compromised. Similarly, periodontal disease, which is completely reversible in the early stages, becomes irrevocably detrimental to the

dentition if advanced too far. Detecting conditions early not only benefits the patient but also saves considerable treatment expense. The economic advantage of early diagnosis is evident in the savings of time and manpower, as complicated procedures typically consume more of both. Grossly neglected dentition that has gone many years without treatment demands a significant burden of attention from the dentist and health care resources of the institution. Patients who have gone a long time between check-ups frequently exhibit multiple problems, as one condition typically leads to another. Conversely, good oral hygiene generally precludes the simultaneous presence of multiple conditions, so the examination and treatment of such patients strain institutional resources and make it difficult to offer timely attention to others. Patients with good prior dental health who come in for check-ups are typically embarrassed and inconvenienced when forced to wait long periods for what should have been a brief appointment. With conditions identified and treated in a timely manner, patients experience greater psychological and physical comfort. Promoting patient awareness regarding the importance of regularly scheduled check-ups is imperative. Furthermore, even in the event that patients are negligent in their care, the gradual progression of dental conditions affords a window of opportunity during which advanced diagnostic technologies may be integrated into practice and the early detection process complemented. Patient knowledge plays a critical role, as inquiry on their part can expedite the identification of incipient conditions. Those who regularly attend check-ups and have good prior oral health typically have only a single condition present, which, in concert with the advanced technologies, allows for its rapid detection. Those who habitually forego check-ups either arrive with numerous conditions or have grossly neglected oral health; in this case, the absence of patient input greatly complicates the diagnosis, as multiple conditions may be present and further complicate one another. Generally, patients who are inspected on a routine basis but have only recently developed a particular condition are most likely to be afflicted by it in a mild form and detected prior to its progression, so that the least invasive treatment possible can be applied. Those who receive timely diagnoses are less likely to have complicated conditions, and thus the overall dental health of the population is improved. A vital link exists between the rapid diagnosis of a particular state of health and the quality of life of the patient thereof. (Bibi et al.2021)(Brandini et al.2021)(Warnakulasuriya et al.2021)

3.2. Challenges in Traditional Diagnostic Methods

Traditional diagnostic methods for oral and dental health care involve a visual examination of the oral cavity, often with the aid of X-rays and hand-held instruments. Although these approaches have been used for many years and have proven effective in diagnosing the majority of cases, they do come with their fair share of challenges (Radwan et al., 2020). A conventional visual examination often lacks accuracy since it relies primarily on the experience of the clinician. Furthermore, it can be time-consuming as it requires patients to be seated in a dental chair with their mouths open for several minutes, which can be an inconvenience, especially for children. Hand-held instruments, such as probes, exfoliators, and brushes, can cause discomfort and sometimes pain to patients. In some areas, the necessary resources for a proper visual examination, such as a dental chair, X-ray, and other equipment, are lacking. Consequently, dental health resources are not evenly distributed, with urban regions having better access compared to rural areas (S Almajed et al., 2024). These challenges can prolong the time taken for a diagnosis to be made, ultimately delaying the treatment and planning of cases. For this reason, many health professionals who are unable to access the necessary services rely on outdated technologies, which can lead to a greater potential for misdiagnosis. Additionally, patients are often hesitant to undergo a traditional examination as it can be uncomfortable, even with the use of X-rays and other instruments. With the advancement of technology, it is necessary to transform the way diagnostic examinations are performed. Furthermore, health care institutions with limited access to proper technology must seek alternative methods for diagnosis other than the conventional practice. On the other hand, the use of innovative technologies can resolve the difficulties faced in conventional practices.

4. Modern Technologies for Rapid Diagnosis

Rapid Diagnosis is a concept that involves the development and implementation of modern systems of technology for the early detection of diseases and health conditions in patients. This text focuses on rapid diagnosis systems in oral and dental health. A review of existing systems of technology used for rapid diagnosis in oral and dental health is presented, along with how these technologies are clinically used. In recent years, a variety of modern technologies have been developed for the rapid diagnosis of health conditions in patients. These diagnostic technologies enhance the accuracy and speed of the diagnostic health assessment process. Several systems of technology have been developed for the rapid diagnosis of oral and dental health. A discussion of these technologies is presented, which can greatly enhance the current procedures for the assessment of oral and dental health conditions in patients. One of the technologies used for the rapid diagnosis of oral and dental health is Digital Radiography. Digital Radiography is a type of X-ray imaging, where digital sensors are used instead of traditional photographic films. This technology provides clearer and high-quality images as compared to traditional radiography with less

amount of radiation exposure. Digital radiography enhances the speed of the diagnostic procedure, as images can be viewed immediately after taking them, and there is no need for time-consuming film processing. Another modern technology system used for the rapid diagnosis of oral and dental health is Intraoral Scanner. An intraoral scanner is an optical scanning device that is used to create a three-dimensional digital representation of the hard and soft tissue surfaces of the patients' dental anatomy. The procedure for using an intraoral scanner is less intrusive and more comfortable than traditional methods. Intraoral scanning creates a precise 3D digital model of a patient's dental anatomy, which can be directly transferred to a computer-aided design program. Cone beam computed tomography is an imaging technique that uses X-ray equipment to take images of a patient's dental structures. A cone-shaped X-ray beam is used to create a three-dimensional image. The major advantage of Cone Beam Computed Tomography is that it provides comprehensive views of the dental structures. This technology is especially useful in endodontics, as it allows for viewing the buccal and lingual sides of the teeth and overall tooth morphology. Dental health-related diseases are among the most common diseases affecting patients. With the advancement of technology, systems of new technology are available for rapid diagnosis. The discussed systems of technology are modern advancements that can enhance the current procedures for the assessment of oral and dental health conditions in patients. Moreover, these technologies are essential tools that can help raise the standard of patient care. (Alauddin et al., 2021)(Patil et al.2022)(Ilhan et al., 2021)(García-Pola et al.2021)

4.1. Digital Radiography

Digital radiography, a crucial development in the dental imaging technology, enables practitioners to capture an image digitally as soon as the patient has undergone the procedure. This significantly reduces the waiting time for the patient, as the images are readily available on the computer screen. The observed images have improved clarity and detail, allowing dentists to examine and diagnose the condition more accurately. Digital radiography offers numerous advantages over traditional radiography systems. For instance, the safety benefits include lower exposure to radiation. In comparison to the traditional X-ray machines, the dental digital radiography system exposes the patient to less radiation (Tallarico, 2020). By the year 2023, most of the dental clinics in Saudi Arabia have adopted the advanced system of digital imaging. Additionally, these systems are cost-effective because, once the system is established, it can significantly lower the overall costs related to the film and processing. Furthermore, the digital radiography system eliminates the production of film; thus, the environmental concerns related to the film wastage are completely diminished, which is aligned with the efforts of making the earth a greener planet as a whole. The implementation of digital radiography in dentistry is expected to have far-reaching implications for enhancing the diagnostic capability of the dental practices across the Kingdom of Saudi Arabia. (Al Sadhan, 2021)

4.2. Intraoral Scanners

Intraoral scanners are the latest technological advancement that improves the efficiency of workflow in dental practices. These devices capture high-resolution 3D images of the oral cavity and store them in STL format (Costa et al., 2022). Intraoral scans take a little more time than traditional impressions, but the results can be viewed almost immediately. The dental practitioner can analyze the diagnostic casts, fabricate a device, and/or plan treatment right away, speeding up the process. Some appliances can even be sent to the lab before the patient leaves the chair and built right away, thanks to the digital workflow.

Intraoral scanning is straightforward. Scanning the patient's mouth takes about 2-10 minutes depending on the case, and the operator just needs to guide the scanner. Furthermore, patients are more comfortable because they do not have to bite down on a bulky impression tray filled with goop. This stress-free experience alone makes intraoral scanning the first choice for most patients. In addition, intraoral scanners are as easy to use as a camera. The software shows guidelines to help operators capture high-quality images. The 3D models are immediately available for review and adjustment, and the need for the laboratory to redo the work due to low-quality impressions is eliminated. Intraoral scanners mitigate the need for traditional impressions as much as possible. Eliminating this step also means eliminating most of the problems associated with it; there might still be a few prosthesis re-dos necessary, but there are far fewer cases than with traditional impressions. Patients also appreciate the change because nobody likes impression material all over their mouth. (Al et al.2021)(Derksen et al.2021)(Takamura et al.2022)

Intraoral scanners are a perfect choice for digital workflows as they are designed to integrate seamlessly into it. The STL files containing the 3D oral scans can be shared easily. Everyone on the dental team can work on the same file at the same time regardless of their location, fostering collaboration. Intraoral scans are able to provide the highest level of accuracy of all of the scan types. Strategies have been developed and algorithms created to minimize the chances of misalignment, which means that intraoral scans usually facilitate the highest quality of the final product. Any errors that might occur while designing a

restoration are dealt with right away, and the restoration is sent to be milled almost instantly. Consequently, dental restorations designed using intraoral scans generally yield better clinical outcomes than restorations designed using other scans.

Intraoral scanning technology used for rapid oral and dental health diagnosis has been proposed in the last few years. It has been thought that the intraoral scanning technology could elevate the standards of dental healthcare in the kingdom of Saudi Arabia. The Intraoral Scanners section reviews the working principles, design, and clinical uses of intraoral scanners, which are modern devices of dental healthcare. (Angelone et al.2023)(Alauddin et al., 2021)(FrąckiewiczB et al.2023)(Sehrawat et al.2022)

4.3. Cone Beam Computed Tomography

Cone beam computed tomography (CBCT) is currently the most widely used imaging technology in dentistry. The capacity of this technology to produce high-quality, three-dimensional images has been demonstrated. Compared to two-dimensional imaging systems, three-dimensional imaging systems are noted for their ability to conduct comprehensive assessments of dental and maxillofacial structures. After the introduction of three-dimensional imaging systems into clinical practice, it was found that these systems produced more precise images of the structures assessed. As a result, three-dimensional imaging systems became essential tools for comprehensive diagnostics, particularly in the assessment of complex cases (Jain et al., 2024). With the aid of three-dimensional imaging systems, diagnosing complex cases becomes simpler, and planning interventions such as implants and extractions becomes more accurate.

CBCT works on the same principle as conventional computed tomography (CT) systems, with differences in technology and design ensuring the production of high-quality images at comparatively lower radiation exposure than traditional CT systems. In CBCT systems, a wide cone-shaped beam is emitted from an x-ray source and captured on a two-dimensional sensor, which at the same time rotates around the object being imaged. The integration of this technology into clinical practice has enhanced the decision-making process for clinicians, enabling them to analyze data that was previously inaccessible. Additionally, the integration of this technology has enabled treatment plans to be more tailored to each patient's needs, improving the quality of treatment rendered. Recently, technology that was previously considered to be an adjunct added only to enhance the capabilities of clinics has become indispensable. This is evident in the growing number of clinics that incorporate this technology into everyday use, as seen in Saudi Arabia, where this technology is rapidly being adopted. (Alfallaj et al.2022)(Khormi et al.2022)

5. Clinical Applications of Modern Diagnostic Technologies in Saudi Arabia

Dental and oral modern systems of technology moving towards the future need reliable clinical applications that ensure desired outcomes (S Almajed et al., 2024). This section familiarizes modern systems of technology clinical applications adopted in dental healthcare practice in the Kingdom of Saudi Arabia. Stressing newly adopted technologies in preventive, restorative, orthodontic, and surgical dental practice, relevant narratives with case studies ensuring positive treatment outcomes and improvements in the success rates have been discussed. Preventive and diagnostic dentistry has been prioritized through modern systems of technology, as early diagnoses help immediately reduce extensive treatments in the future. Illustrating routine treatment procedures, necessary demonstrations to bring simplicity in preventive caries control and digital's capability in caries detection have been depicted. Furthermore, the modern systems of technology have been emphasized in restorative practices, explaining how the procedures generally conducted without technology would be much simplified in terms of time and reliability by simply adopting the placement of a crown implant. In orthodontics, the ability of technological advancement imaging to enhance treatment planning and design of the appliance, as well as the capability of technology in monitoring during the growth and development stage bringing accuracy in planning, have been elaborated with examples. In surgical practice, how modern systems of technology precision intervention strategies would be difficult without the technology are exhibited through procedural detail and technique progress changes over the years. Overall, these advances in the clinical applications of modern systems of technology in dental practice demonstrate a shift toward optimized approaches that ensure reliability in treatment outcomes.

5.1. Preventive Dentistry

Preventive dentistry is a key field for the effective use of modern systems of technology in rapid diagnosis. Many potential problems in oral health can be quickly assessed by a practitioner before they turn into serious complications. A rapid, modern system of diagnostics – whether it be the use of laser fluorescence, fiber optics, or the simple modern intraoral camera – can identify these problems when they are still in their infancy, ensuring the effectiveness of preventive measures (Radwan et al.,

2020). For instance, a small cavity in a tooth can be treated with far less effort and expense than a root canal treatment, so the earlier this problem is determined, the better. Preventive dentistry revolves around this principle: it is always better to intervene before there is a problem than to wait for a problem to occur. Using data compiled over years of patient visits, practitioners can be more aware of patients who may have the greatest potential for developing complications in oral health. It is possible to recognize trends in oral health: for example, one patient may have a cumulative history of developing cavities in certain teeth, whereas another may have no cavities but consistently develop problems with gum health.

Some modern systems, such as digital radiography or intraoral scanners, allow for a thorough examination of the patient's teeth at the first visit, thus providing the dentist with a wider view of the patient's oral health and the ability to keep a closer watch over them throughout time. Sealants are preventive measures taken to prevent the formation of cavities in posterior teeth, which are more difficult to access because they are in the back of the mouth and have grooves where food can pack and bacteria can thrive. A sealant completely fills this groove with a composite resin, thereby preventing food from entering it. The effectiveness of sealants is relatively high, but they can fall out; therefore, the patient should be kept under observation. Digital radiographs taken during the sealant procedure can be saved and compared to future radiographs in order to determine whether the sealant remains intact or if it has fallen out and a cavity has formed. Fluoride can be applied to erupted teeth to prevent the formation of cavities. Fluoride use should always be monitored. If applied in excess, it can form white opacities on the teeth known as enamel fluorosis. Unfortunately, many patients are unaware of the fluoride content in dental products and drinking water; therefore, education regarding such products and their effects on oral health is necessary. Another important aspect of preventive dentistry is education regarding a patient's oral health: the best way to effectively reduce the chances of developing complications is to make the patient aware of their oral health. Many patients mistakenly believe that a dentist's only role is to fix teeth and thus do not visit regularly. Regular check-ups allow the dentist to monitor the health status of the teeth and gums and to remove any calculus that may be present. Calcareous deposits cause and aggravate gum disease; thus, keeping teeth clean is vital to maintaining healthy gums. Most patients visiting the dentist only when there is a problem with their teeth will require more extensive treatment, whereas those who visit regularly will need much less treatment. Finally, there is potential for the use of data analytics in dental practices to determine the best treatment plan for the patient based on their unique biology and health history. (Yazdanian et al.2022)(Putra et al.2022)(Izzetti et al.2021)

5.2. Restorative Dentistry

In restorative dentistry, modern diagnostic technologies are increasingly used to allow clinicians to assess dental structures and plan restorations. In many dental practices, advanced diagnostic tools have become part of routine clinical work and play an important role in good clinical practice and patient safety. Piece-specific diagnostics using modern systems of technology have been shown to improve the fit of dental crowns and other restorations by ensuring the precise determination of the necessary data for computer-aided design and manufacture. Digital impressions can be created via intraoral scanning, making it possible to replace impression techniques based on impression materials. Digital impressions offer a number of advantages, including reducing the time needed to fabricate a restoration, improved accuracy, and higher patient comfort (Tallarico, 2020). Furthermore, consistent monitoring and diagnostics are essential for the long-term success of restorative procedures. With modern systems of technology, it is possible to monitor the precision of fit of indirect restorations before cementation and, thus, reduce the potential for clinical failure. These advanced diagnostic technologies can easily be integrated into existing digital workflows, which are steadily gaining acceptance in dental practices. A digital workflow allows for comprehensive planning of the treatment sequence surrounding a restorative procedure. Modern systems of technology used in diagnostic dentistry can significantly enhance the capabilities of restorative dentistry. (Joda et al.2021)(DaSilva et al.2022)(Javaid et al.2021)

5.3. Orthodontics and Oral Surgery

The Effect of Modern Systems of Technology for Researching Oral and Dental Health on Patient's Health Rights The subsection elaborates on the transformative effects of the modern systems of technology in researching oral and dental health on the practice of orthodontics and oral surgery. The primary focus is on how advanced imaging techniques have improved the assessment and planning stages in orthodontic treatments. These technologies facilitate the planning of orthodontic treatments clearly and precisely in a "succeeding outcome" manner (Kumari et al., 2016). For example, the innovative use of intraoral scanners allows accurate tracking of tooth movement and alignment over time. This helps prevent accumulating discrepancies in tooth movements induced by orthodontic forces and passive retention from tooth movement due to growth or alignment errors. In this way, linear predictive mathematics was successfully applied to digital 3D models obtained from intraoral scanners for the post hoc evaluation of orthodontic treatment outcomes. Moreover, the impact of modern systems of

technology that provide 3D imaging on oral surgery is discussed. It is highlighted that 3D perspectives from cone beam computed tomography (CBCT) are essential in evaluating complex cases and modifying surgical plans ahead of time and that 3D models greatly assist in pre-surgical planning and risk assessment. It is shown that case studies of impacted teeth that are closely situated to vital anatomical structures and complain associated with facial asymmetry increased the success rate of surgical intervention from 87% to 98% and 75% to 100%, respectively, when aided by modern systems of technology for researching oral and dental health. The importance of 3D perspective models in precisely locating the area of orthodontic expansion when using mini-plates in a multi-disciplinary approach is presented. Furthermore, an understanding of how modern systems of technology that aid in the diagnosis of complex cases improves collaboration among a multi-disciplinary team is provided. Multi-disciplinary teams are needed when orthodontic treatment is accompanied by surgical intervention due to prior development of the dentocraniofacial complex. It is noted that prior to the application of the modern systems of technology in diagnostics, general practitioners collected all possible 2D images and observations from different angles, and oral surgeons relied only on 2D images and the surgeon's perspective of the problem since 3D perspectives were not clearly interpreted. Lastly, it is focused on how the modern systems of technology in diagnosing oral and dental health affect patient comfort and treatment satisfaction. It is emphasized that modern systems of technology have made orthodontic treatment less invasive compared to previously required treatment and hence better patient experiences. With regard to comfort during imaging, intriguing feedback from patients during the transition of 2D systems to 3D systems is shared. (Kaasalainen et al., 2021)(Robotti et al.2021)(Palczewska-Komsa et al.2022)

Conclusion

In conclusion, the integration of modern diagnostic technologies into oral and dental healthcare in the Kingdom of Saudi Arabia holds immense potential for improving both the speed and accuracy of diagnoses. Technologies such as fluorescence imaging, laser-induced imaging, and intraoral scanning represent significant advancements that can provide precise early detection of dental issues, ultimately leading to more effective treatment outcomes and cost savings. As the country continues to grow and develop its healthcare infrastructure, the adoption of these advanced diagnostic systems is essential in addressing the challenges of oral health, particularly in rural areas. By embracing these technologies, the Kingdom of Saudi Arabia can enhance its dental care services, ensuring better health outcomes for its population while promoting the efficient use of healthcare resources.

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