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Pros and Cons of Orthodontics in the Era of Technology in Saudi Arabia: Systematic Review Based Findings

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Abstract

Background: The research was carried out to understand the pros and cons of orthodontics in the era of technology in Saudi Arabia. Aim: The purpose of the systematic review is to carefully analyze the existing literature on the pros and cons of orthodontics and technology linked with orthodontic practices in the field of dentistry. Method: A systematic search of databases including PubMed and Google Scholar was conducted to identify relevant studies published between 2013-2023. The inclusion criteria for this study consisted of selecting articles written in English that specially examined the use of technology involved in orthodontics treatment and prognosis. After initial screening and quality assessment, ten studies were included in the synthesis. Results: The technology has been widely applied for identifying cephalometric landmarks, determining the need for orthodontic extractions, determining the degree of maturation of the cervical vertebra, predicting the facial attractiveness after orthognathic surgery, predicting the need for orthodontic treatment, and orthodontic treatment planning. Most of these models are based on either artificial neural networks (ANNs) or convolutional neural networks (CNNs). Different technological instruments used in orthodontic treatments have more advantages than disadvantages reported by patients and healthcare professionals. Conclusion: The results from these reported studies suggest that these automated systems have performed exceptionally well, with accuracy and precision similar to the trained examiners. These systems can simplify the tasks and provide results in quick time, which can save the dentist time and help the dentist to perform his duties more efficiently. These systems can be of great value in orthodontics and dentistry.

Keywords: *Orthodontics, Technology, Patient, Pros and Cons, Saudi Arabia, Systematic Review, Artificial Neural, Convolutional Neural*

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Introduction

The field of dentistry has recently experienced many technological advancements that have changed the dimensions of many subspecialties of dentistry. To further improve and enhance dental education and the clinical application of dentistry, innovations have been introduced. These include augmented reality (AR) and virtual reality (VR), which have been introduced and studied with the goal of improving dentistry(Nguyen & Jackson, 2018). Orthodontics is one of the nine dental specialties that focus on the identification of malocclusions with the goal of preventing and curing them. It is concerned primarily with the craniofacial skeleton, particularly having a focus on dentoalveolar modification. Because an accurate diagnosis and treatment plan is critical to the effectiveness of orthodontic treatment, orthodontists must be extremely exact when diagnosing and planning treatment. Orthodontic diagnosis is mostly dependent on the patient's dental and medical history, clinical examination, study models, and cephalometric radiographs, which are the most important tool for orthodontic diagnosis since they are used to identify abnormalities in the dental and craniofacial skeleton (Alqahtani et al., 2022).

The orthodontic need assessments in Saudi Arabia have revealed that crowding was the most common malocclusion trait, followed by increased overjet and spacing. It has been reported that 40–62.4% of the population needs orthodontic treatment. Because of greater awareness of the benefits of orthodontic treatment, the number of people seeking orthodontic treatment has increased during the previous two decades. The rising demand for orthodontic treatment, along with the government’s limited ability to offer orthodontic services, has prepared the way to establish orthodontic clinics in Saudi Arabia (Baseer et al., 2021).

One of the most complicated fields of dentistry, orthodontics and dentofacial orthopedics necessitates the careful analysis of a vast quantity of data in order to arrive at an accurate diagnosis and treatment plan. Since the introduction of three-dimensional techniques, which have found different uses in orthodontics as well as oral and maxillofacial surgery, imaging technology in the dentistry sector has emerged as one of the most significant parts of identifying and managing oral problems. The technological age that has transpired in recent times has had a tremendous impact on orthodontics. The orthodontist now has access to a wealth of digital documentation that aids in orthodontic diagnosis, treatment planning, as well as follow-up. Concurrent cone-beam computed tomography is increasingly used in conjunction with digital radiographs and digital pictures, which have largely supplanted traditional techniques of physical imaging (Alqahtani et al., 2022).

Orthodontic diagnosis is comprised of three components: facial, dental, and skeleton an orthodontist's major job is to reposition the various components of the craniofacial complex in anatomical and dynamic balance while also making them aesthetically acceptable. This procedure necessitates knowledge of the relationships between all of the components of the craniofacial complex in three spatial planes. The majority of traditional diagnostic aids simply show a two-dimensional depiction of the patient (Alqahtani et al., 2022).

Advanced technology provides orthodontists with high-quality diagnostic evidence in three dimensions, allowing them to create effective treatment plans for their patients. Digital dental models, the use of digital dental set-ups to simulate the eventual result of orthodontic therapy, and three-dimensional imaging of the dentofacial region are among the technological advances that provided new choices for patient documentation. Recent and valuable technologies for orthodontic diagnosis and treatment planning include multi-slice computed tomography and lower dosage cone-beam computed tomography(Baseer et al., 2021).

Most Saudi dental practitioners are reluctant to incorporate the technology of (3D) printing into their clinical practice, due to insufficient knowledge. This indicates the need to increase the comprehension of the 3D imaging applications and understand their

various techniques in order to improve and elevate the quality of dental treatments in KSA. Limited studies have been done regarding 3D printing, imaging applications and their techniques (Marghalani et al., 2023). The COVID-19 pandemic is pushing digital technology (DT) towards becoming one of the most crucial and irreplaceable technologies in dentistry, due to its ability to provide serenity regarding safety, increase workflow efficiency, and likely increase profit as well. In an era of infectious diseases, dental patient safety must always be guaranteed when using all forms of dental technology. It is well known that CAD/CAM technology has major advantages that go beyond infection prevention, and which are widely discussed in other papers surrounding this issue (Barenghi et al., 2021)..Developments in three-dimensional imaging and manufacturing processes have made the customization of orthodontic appliances to improve treatment efficiency possible. Advances in technology have yielded two patient-specific products that utilize computers to create an interactive treatment plan, and then manufacture a custom-designed appliance.

As we navigate the complexities of modern life, orthodontics and other fields of dentistry are found to be associated with technology and are getting benefits from technology. By delving into the nuances of technology, acknowledging its far-reaching positive consequences, and embracing fruitful impacts, surgeons and oral health professionals are using and getting results in the form of improved individuals' lives.

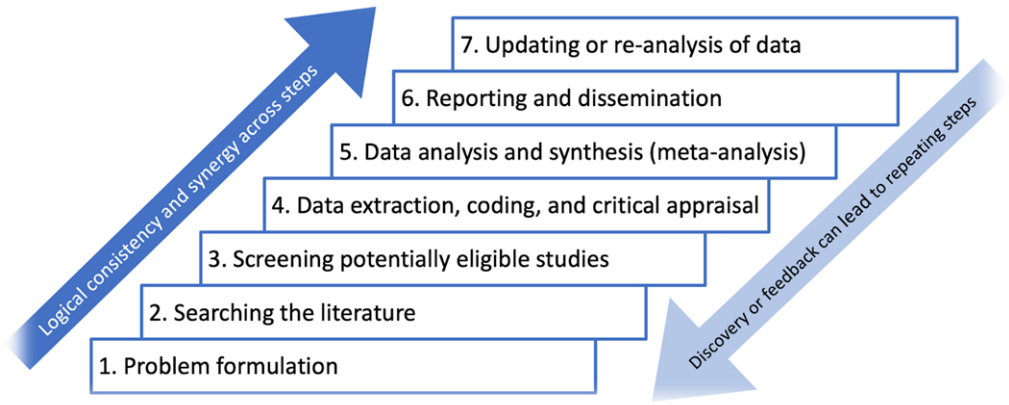

Figure 1: Conceptual Diagram of Systematic Review

Methodology

Literature Search

A comprehensive literature search was conducted to identify relevant studies investigating the Pros and Cons of technology on orthodontic practices in the field of oral health. The search was performed using articles published and included in databases like Google Scholar and PubMed. An initial search of databases for research on, the ‘Pros and Cons of technology on orthodontics "’ resulted in 277 results while a search on ‘technology and orthodontics "’ resulted in 555 while results for ‘Impact of technology on orthodontics "’resulted in 248 results. Overall, a large number of researches were scanned.

The search strategy employed the use of keywords to optimize the retrieval of relevant articles. The following search terms and their variations were used: "technology and orthodontics," "dentistry and technology" "oral health technology," and "Pros and Cons of technology." There were no restrictions on date, language, participant age, or type of publication. The search was not limited by publication date however only the publications in the English language were accessed. The PRISMA diagram provides complete details for research identified, screened, and included in the systematic review.

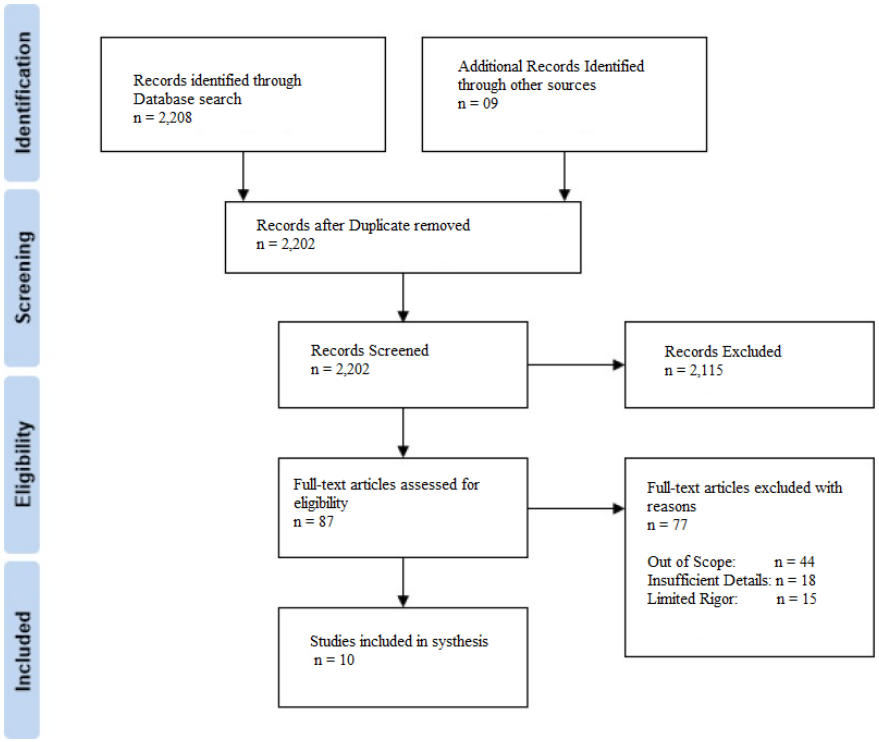

Figure 2: PRISMA Flow Diagram for Systematic Review

Inclusion/ exclusion Criteria

Studies were included in the review if they investigated the use of the technology in orthodontics or oral health or diseases that are similar to oral health problems and assessed the impact of the technology on orthodontics.

Included participants diagnosed with ortho problems and have gone through different forms of surgeries with the use of technological advancements, which are part of dentistry in modern times.

Reported quantitative data related to the pros and cons of technology used in orthodontic practices for oral health issues.

Studies were excluded if they were not relevant to the impact of technology and its pros and cons associated with the treatment of patients facing dental health issues. Another reason for exclusion was duplicate publications and non-experimental research.

Data Extraction

To gain a better understanding of the similarities and general direction of the research, data related to study design, reported illness, sample size, intervention type, details pertaining to the intervention/s, time after which the assessment was performed and findings and scales are measures used in the study was noted and extracted from original articles. The focus was to extract the pros and cons associated with the use of technology in the field of orthodontics.

Systematic Analysis of Research

	Author	Study	Year of publication	Material/Method/Sample	Technology/ Treatment	Advantages	Disadvantages	Study Results	Author Suggestions /Conclusion
1	(Alqahtani et al., 2022)	Digital diagnostics and orthodontic practice	2022	Digital dental models, the use of digital dental set-ups to simulate the eventual result of orthodontic therapy, and three-dimensional imaging of the dentofacial region are among the technological advances that provided new choices for patient documentation	Digital Radiography vs Traditional radiograph Maxillary tuberosity	Intraoral scanning enabled a more thorough diagnosis, as well as more precise and efficient treatment planning.	There are certain drawbacks, such as the scanner tip size, which makes reading the maxillary tuberosity region difficult. Other limitations include the patient's mouth opening restriction, humidity management such as saliva, and light reflection by mini-implants and bars during scanning	Impact of digital diagnostics in orthodontic treatment planning showed that in 9.2% of the cases, the treatment strategy was significantly altered after examining the digital setups. Changes such as modifying the extraction pattern or recommending space closure rather than opening space for an implant were among them. In another 14.4% of patients, treatment plans were modified in some way, such as by adding interproximal reduction or temporary anchoring devices	Digital technology has already become important in modern dentistry, and three-dimensional technology in orthodontics has grown in popularity in recent years. Intraoral and face scanners, digital radiology, and conebeam-computed tomography have all helped to convert diagnostic and treatment planning from a two-dimensional to a three-dimensional approach. However, more research is needed to generate evidence-based Journal of Healthcare Sciences 116 http://dx.doi.org/10.52533/JOHS.2022.2605 results regarding the utilization of digital diagnostics in orthodontics.
2	(Gudipane	The	2018	A	Orthodontic	The	-	Class I (52.8%	The

	ni et al., 2018)	prevalence of malocclusion and the need for orthodontic treatment among adolescents in the northern border region of Saudi Arabia: an epidemiological study		descriptive cross-sectional study was conducted among 500 (mean age 16.25 ± 1.09) adolescents randomly selected from the northern border region of Saudi Arabia (KSA). The northern border region is subdivided into three governorates: Ar'ar (186), Rafha (142) and Turayf (172). The data were recorded in questionnaires to assess the prevalence of malocclusion and estimate of DHC of the IOTN index	Treatment for Malocclusion	grades of orthodontic treatment using DHC of IOTN index.		Class II (31.8%Class III 15.4% crowding 47.2% excessive overjet (> 2 mm) (22.2%), reduced overjet (< 1 mm) (11.4%), excessive overbite (> 2 mm) (23.4%), reduced overbite (< 1 mm) (12.2%), anterior crossbite (4.8%), posterior crossbite (9.4%) and open bite (4.6%). The most common facial profiles determined in the sagittal plane, were the straight facial profile (49.2%). The grades of DHC of IOTN index were as follows: 48.73% of males and 50.22%	prevalence of malocclusion and orthodontic treatment need among the north border region of KSA is comparable with that of other regional studies
3	(Baseer et al., 2021)	Oral Impacts Experienced by Orthodontic Patients Undergoing Fixed or Removable Appliances Therapy in Saudi Arabia: A Cross-Sectional Study	2021	A cross-sectional study was carried out among a sample of active orthodontic patients in Riyadh City, Saudi Arabia. sample of (N=150) orthodontic patients undergoing fixed and removable treatment was calculated by considering alpha error	Orthodontic treatment for Malocclusion	Computerized tools are helpful to treat Malocclusion	Orthodontic appliances are expected to negatively impact OHRQoL because of the position and design of removable and fixed appliances.	The fixed orthodontic patients compared to the removable orthodontic cases showed significantly higher difficulty in sleeping (1.28±1.10 vs 0.94±0.88, p=0.024), sores on the tongue (0.97±1.00 vs 0.56±0.76, p=0.042) and cheeks (1.20±1.11 vs 0.72±0.81, p=0.027), and the presence of food debris under the appliance	The fixed orthodontic treatment compared to removable orthodontic treatment resulted in more severe pain, sleeping difficulty, sores on the tongue and cheeks, and food impaction after one week of appliance activation

				probability of 0.05, power 0.80, allocation ratio of 0.271, and effect size of 0.58 required for the Wilcoxon-Mann–Whitney test				(1.53±1.16 vs.1.00±0.95, p=0.021). Moreover, the oral health impact score showed a significant positive correlation with the duration	
4	(Marghalani et al., 2023)	knowledge, attitude and practice assessment regarding 3D imaging among dental practitioners in Saudi Arabia	2023	This is a cross-sectional study based on a structured questionnaire that was developed by the authors and was conducted in Saudi Arabia.	3D-Imaging for orthodontic treatments	Effective to treat orthodontic issues	80.1% reported high cost as disadvantage of 3D imagining while 12.5% thought it was hard to perform. Benefits of using 3D imaging was reported as less radiation dose by 19%, no developing required 28.5%, short time 35.5% and easy to store data 40.4%.	The study included 1574 participants, 58.1% of them were males and 41.9% were females. 40.2% were intern, 38.4% had less than five years of experience, 12.4% had 5-ten years of experience and 9% had more than ten years of experience. 91.4% of participants think that 3D imaging has advantages over other digital imaging modalities.	The study shows that Saudi dentists have moderate knowledge of 3D imagining in dentistry. Knowledge levels have a strong correlation with ages, practice, residence region, gender and work experience.
5	(Barenghi et al., 2021)	Pros and Cons of CAD/CAM Technology for Infection Prevention in Dental Settings Durings COVID-19 Outbreak	2022	The COVID-19 pandemic is pushing digital technology (DT) towards becoming one of the most crucial and irreplaceable technologies in dentistry, due to its ability to provide serenity regarding safety, increase workflow efficiency, and likely increase profit as well. In an era of	-	During the COVID-19 pandemic, the distinctive advantages of DT are the reduction of close contact with patients and DHCWs (within 6 feet), and limited transmission through respiratory droplets and AGP. Intraoral scanners (IOS) result in	-	Voice command to avoid hand touching; • Antimicrobial surfaces and antimicrobial-coated barriers, silicone barriers, and opticalmedical-grade barriers to avoid surface contamination; • Wand tip smaller dimension and speedier scanning to reduce close contact with patients; • Scanner accuracy improvement;	For patient and DHCW safety against infectious and SARS-CoV-2 risk, many structural, electronic, and operational characteristics of scanners and CAD/CAM technology are important

				infectious diseases, dental patient safety must always be guaranteed when using all forms of dental technology. It is well known that CAD/CAM technology has major advantages that go beyond infection prevention, and which are widely discussed in other papers surrounding this issue		significantly decreased discomfort in the mouth opening. Additional Advantages of Digital Scanning to Avoid Compression of Mucosal Tissues and to Detect OML			
6	(Sawady et al., 2023)	An Overview to Depict the Role of Invisalign to Fix Deep Bite	2023	3D-cutting edge computer imaging technology	-	It employs removable trays rather than brackets that are bonded to the teeth and connected with wires to straighten the teeth. 2. It delivers exact treatment because the trays were made using digital photography.	The attachments adhere to the outside of your teeth like the brackets of conventional braces. These could offer a favorable spot for plaque to accumulate. 2. When you have attachments, if you don't maintain appropriate oral hygiene, plaque build-up around the attachments may eventually cause staining or discoloration in these locations.	Utilizing cutting-edge 3D computer imaging technology, Invisalign treatment is essentially an invisible way to straighten your teeth	The Invisalign appliance's transparency increases its aesthetic appeal for adult patients who are uncomfortable using traditional labial fixed orthodontic appliances. Despite claims of evident aligner effectiveness, evidence is often inadequate. The only substantial effectiveness of transparent aligners over conventional systems that is supported by current evidence appears to be reduced treatment

									duration and chair time in mild-to-moderate instances.
7	(Nguyen & Jackson, 2018)	3D Technologies for Precision in Orthodontics	2018	Orthodontic appliances, which utilize 3D technology such, customized wires and CAD/CAM fabricated brackets. Customized arch wires are planned from 3D virtual setup and robotically bent	3D intra-oral scanning, cone beam computed tomography (CBCT), 3D printing and computer-aided design and computer-aided manufacturing (CAD/CAM) technology	A decrease in treatment time with the use of customized wires, technology is fairly accurate for mesial-distal tooth movements, CAD/CAM brackets were initially shown to be more effective and efficient when compared to standard brackets	Data on quality of treatment results are conflicting. While this technology is fairly accurate for mesial-distal tooth movements, it is less precise for crown tip and root torque	CAD/CAM brackets were initially shown to be more effective and efficient when compared to standard brackets, but a follow-up study showed no difference in the quality of treatment of outcomes.	The study also showed the majority of the reduction in treatment time resulting from CAD/CAM brackets may be due to the indirect bonding process rather than the personalized milled slots.
8	(Almasoud, 2018)	Pain perception among patients treated with passive self-ligating fixed appliances and Invisalign® aligners during the first week of orthodontic treatment	2018	This prospective study conducted in Saudi Arabia used an estimated sample of 64 patients from a private dental clinic. After obtaining written informed consent, the patients were divided into two groups; one group (n = 32) was treated using passive self-ligating fixed appliances and the other group	Self-Ligating Fixed Appliances	Patients treated with Invisalign aligners had significantly lower pain levels (mean VAS scores) than did those treated with passive self-ligating fixed appliances at 4 hours, 24 hours, day 3, and day 7 (p = 0.001). The highest pain levels for both	-	A lower percentage of patients treated with Invisalign aligners reported pain than did patients treated with passive self ligating fixed appliances, and these differences were statistically significant (p = 0.001). Similarly, the mean VAS score for the Invisalign group was significantly lower than that for the passive self-ligating fixed appliance group at different intervals during the first week of	During the first week of orthodontic treatment, patients treated with Invisalign aligners reported lower pain than did those treated with passive self-ligating fixed appliances.

				(n = 32) using Invisalign® aligners. Immediately after fitting the appliances, the patients' perception of pain was evaluated through a close ended and coded self-administrated questionnaire by using a visual analog scale (VAS). Their responses were recorded at 4 hours, 24 hours, day 3, and day 7. Mann-Whitney U-test, Kruskal-Wallis test, and Pearson's chi-square test were performed for statistical analysis		groups of patients were recorded at 24 hours (mean VAS scores of 1.38 and 6 for the Invisalign aligner and passive self-ligating fixed appliance groups, respectively) after the initial placement of orthodontic appliances.		treatment. The intensity of pain with both appliances peaked at 24 hours (mean VAS score, 3.87) and was lowest (mean VAS score, 1.62) on day 7.	
9	(Marya & Venugopal, 2021)	The Use of Technology in the Management of Orthodontic Treatment-Related Pain	2021	Computerized indirect bonding to virtual treatment planning, technology has slowly become a vital part of an orthodontist's repertoire.	Lower-Level laser therapy (LLT), LEDs, Virtual Reality, TENS	Computerized treatment plans and therapies are useful in pain management of orthodontic patients.	The problem with current modalities is that even being effective, they are not based on a precise neurobiological principle.	It has been seen that low-level laser therapy induces cellular proliferation which results in differentiation of osteoblasts bringing about bone formation [11–13]. Low-energy lasers have also been found to help enhance orthodontic tooth movement, but more research is still being conducted on the same	All the mentioned therapies like Lower-Level laser therapy (LLT), LEDs, Virtual Reality, TENS are helpful in pain management.
10	(Felemban et al.,	Factors influencing	2022	A cross-sectio	Orthodontic treatment	The primary	-	A total of 417 subjects	The main reason for

	2022)	the desire for orthodontic treatment among patients and parents in Saudi Arabia: A cross-sectional study		nal survey was distributed to the patients of orthodontic clinics of King Abdulaziz University in addition to a private orthodontic clinic in Jeddah city, Saudi Arabia. The survey consisted of two versions of a questionnaire: one for adults and one for children's parents. The survey inquired about the participants' demographics, factors that led to the necessity of treatment, and considerations before opting for orthodontic treatment.	for Malocclusion	reported reason for seeking orthodontic treatments among children's parents was to enhance the esthetic appearance (87.2%), which was more often than adults (58.6%), with a statistically significant difference (P < 0.001)		participated, 331 adults and 86 parents. The majority of the respondents in both groups were females. When compared to children, adults were more aware of the necessity for orthodontic treatment (78.5% of adults vs. 41.9% of children). The primary motivation for adults and parents to begin orthodontic treatment was to improve their esthetic appearance (58.6% and 87.2%).	opting for orthodontic treatment in Jeddah city, Saudi Arabia was esthetic for both adults and children by using different modern treatment technologies

Discussion

The present systematic review aimed to investigate the pros and cons associated with technology and orthodontics in the field of dentistry. The review synthesized findings from a range of studies, including those conducted by different researchers which are (Alqahtani et al., 2022), (Sawady et al., 2023), (Baseer et al., 2021), (Marghalani et al., 2023), (Felemban et al., 2022), (Barenghi et al., 2021) (Marya & Venugopal, 2021), (Almasoud, 2018), (Nguyen & Jackson, 2018), (Gudipaneni et al., 2018). Through the analysis of these studies, valuable insights into the potential pros and cons of orthodontics and technology usages have emerged.

The systematic analysis reveals that one of the most complicated fields of dentistry, orthodontics and dentofacial orthopedics necessitates the careful analysis of a vast quantity of data in order to arrive at an accurate diagnosis and treatment plan by using different technological advanced tools. Since the introduction of three-dimensional techniques, which have found different uses in orthodontics as well as oral and maxillofacial surgery, imaging technology in the dentistry sector has emerged as one of the most significant parts of identifying and managing oral problems. The technological age that has transpired in recent times has had a tremendous impact on orthodontics. The

orthodontist now has access to a wealth of digital documentation that aids in orthodontic diagnosis, treatment planning, as well as follow-up. Concurrent cone-beam computed tomography is increasingly used in conjunction with digital radiographs and digital pictures, which have largely supplanted traditional techniques of physical imaging (Alqahtani et al., 2022).

There are several advantages of digital radiography over traditional radiography in field of orthodontics such as while the patient is still seated, the image can be visualized, the chance of the video being incorrectly linked to another patient's file is reduced, and printing errors are no longer a possibility. Allows for rapid adjustment of brightness and contrast inconsistencies. Calibrates photos as soon as possible. Allows the digital radiograph to be overlapped with the digital picture. Provides photos of a higher quality than the standard. The application of digital diagnostics such as cone-beam computed tomography in field of orthodontics include an examination of the skeletal and dental structures, jaw skeleton relationship, symmetry or asymmetry, three-dimensional analysis of impacted tooth structure and location. Evaluation of progress, analysis of the pharyngeal airway, three-dimensional analysis of the temporomandibular joint complex and evaluation of a cleft palate (Alqahtani et al., 2022)

When compared to removable orthodontic treatment, our findings indicated that the fixed orthodontic patients experienced significantly higher sleep difficulty, ulcers on the tongue and cheeks, and food impaction beneath the appliances. Moreover, the length of orthodontic treatment and pain intensity has shown a significant positive correlation with oral health impact score. Furthermore, income level was found to affect the oral health quality of life of orthodontic patients. Hence, our study hypothesis is accepted that there is a difference between removable and fixed appliance patients in terms of daily activity limits, food consumption, and oral symptoms A3. orthodontic patients had a higher incidence of mucosal sores on the lips, tongue, and cheeks due to the use of metal brackets, wires, and bands, which increases the risk of mucosal irritation than the removable appliance therapy(Baseer et al., 2021). The removable orthodontic appliance facilitates brushing and flossing, contributing to improved oral hygiene and oral health among orthodontic patients.34 However, reported data on removable and fixed orthodontic treatment modalities of oral hygiene maintenance are indecisive since plaque and gingival scores between the two treatment options are comparable. The plaque accumulation in fixed orthodontic treatment is evident around the brackets (Baseer et al., 2021)

Saudi dentists have moderate knowledge of 3D imagining in dentistry. Due to its extensive uses and significant promise across a wide range of dental specialties, precise knowledge of 3D printing and imaging modalities is crucial for improved treatment outcomes, patient perception and satisfaction in the dental community. (Marghalani et al., 2023) Technology-enabled innovation will make it possible to provide healthcare that is more precise, effective, and communication enhancing. Orthodontists must not only consider the patient's needs today, but also be able to make use of the new technology equipment at their disposal to produce the most stable, health promoting, and aesthetically pleasing results. The orthodontist's main objective is to enhance the patient's overall quality of lifeA6. alternative orthodontic equipment have been developed since the invention of conventional fixed orthodontic appliances to help patients reach the skeletal, alveolar, and oral objectives specified by orthodontists. Any novel appliance that is introduced comes with the challenging task of assessing its clinical performance and efficacy. (Sawady et al., 2023)

The intensity of pain progressively decreased during the first week of fitting the orthodontic appliances. Moreover, Presence of pain in the Invisalign and passive self-ligating fixed appliance groups Time Invisalign aligners Passive self-ligating fixed appliances (Almasoud, 2018)

One of today's significant diagnostic tool advances in orthodontics is the development of digital scanners coupled with computer-aided design. The assessment for diagnosis, treatment planning, and prediction of the eventual outcome is one of the most important applications in orthodontics. However, the research studies regarding the clinical application and evidence of utilization of digital diagnostics in field of orthodontics are lacking. Hence, more clinical research-based studies are need of time to better signify the importance and benefit of digital diagnostics and use of technology to understand the advantages and disadvantages in orthodontics clinically (Alqahtani et al., 2022; Al Ali et al., 2022; Oraibi et al., 2022).

This comprehensive review offers an invaluable contribution to the domain of orthodontics and technology driven solutions for the patients facing different orthodontic problems. By unearthing the effects of various technologies in orthodontics in the context of Saudi Arabia, the review will help patients and dental health professionals to critically analyze different advantages and disadvantages, which technology driven instruments are offering for oral health professionals.

Implications

The current systematic review on pros and cons of orthodontics in the era of technology lead to know the advantages and disadvantages associated with the use of technology in orthodontics. The research comprehensively addresses the pros and cons associated with the use of technology in orthodontics. It will help the researcher and other healthcare professionals to carefully use different technological equipment by keeping in view their advantages and disadvantages.

Limitations

Despite the promising findings, it is important to acknowledge the limitations across the studies. Due to limited studies with similar variables, the heterogeneity in this study’s design, patient population, and outcome measures poses challenges for direct comparison and generalization of results. Additionally, variations in the implementation of the technology associated pros and cons in the field of orthodontics vary across different healthcare practitioners and patients.

Recommendations/Suggestions

By keeping in view, the current systematic review on pros and cons of technology in orthodontics, it can be recommended for future researchers to further explore the other fields of dentistry as well where technology is playing vital role for the well-being of patients. More researches should be explored for generalization of the findings. Technology driven assessments and treatments are more accurate and found to be more patient-oriented as the review showed that patients and their parents are more satisfied with sophisticated equipment used for orthodontic treatments are reported more advantages than disadvantages.

Conclusion

In conclusion, with the advent of technology, the field of orthodontics is slowly but surely treading the digital path. From computerized indirect bonding to virtual treatment planning, technology has slowly become a vital part of an orthodontist’s repertoire with its pros and cons. the studies included in this systematic review collectively suggest that the technology has already become important in modern dentistry and three-dimensional

technology in orthodontics has grown in popularity in recent years. Intraoral and face scanners, digital radiology, and conebeam-computed tomography have all helped to convert diagnostic and treatment planning from a two-dimensional to a three-dimensional approach. However, more research is needed to generate evidence-based

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