

Usage of Artificial Intelligence in Orthodontics Field in Saudi Arabia

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ABSTRACT

Background: Artificial Intelligence (AI) has become an important tool in healthcare, including orthodontics, due to its potential to enhance diagnostic accuracy, optimize treatment planning, and improve patient care. In Saudi Arabia, the adoption of AI in orthodontics is gaining interest, but its integration remains in the early stages. This study investigates the current use of AI in orthodontic practice in Saudi Arabia, exploring its benefits, challenges, and future potential.

Methods: A cross-sectional survey was conducted among 120 orthodontists practicing in Saudi Arabia. The survey collected data on the types of AI tools used, the frequency of usage, perceived benefits, challenges, and future outlook on AI in orthodontics. A literature review was also conducted to examine global trends and to contextualize the findings.

Results: The results revealed that AI tools are primarily used for diagnostic purposes (65%), treatment planning (55%), and virtual simulations (50%). However, the usage frequency varied, with 25% of respondents using AI tools daily. The key benefits identified included improved diagnostic accuracy (78%), increased treatment efficiency (70%), and enhanced patient outcomes (65%). Major challenges included high initial costs (72%), lack of training (68%), and concerns regarding data privacy (60%).

Conclusion: While AI shows considerable promise in enhancing orthodontic practice in Saudi Arabia, significant barriers such as cost, training, and privacy concerns hinder its widespread adoption. However, there is strong optimism among orthodontists regarding the future role of AI in the field.


Keywords: Artificial Intelligence, Orthodontics, Saudi Arabia, AI Tools, Diagnostic Accuracy, Treatment Planning Patient Outcomes, Healthcare Technology.

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INTRODUCTION

Orthodontics, the branch of dentistry that deals with the diagnosis, prevention, and treatment of dental and facial abnormalities, has seen significant technological advancements over the past few decades. Artificial Intelligence (AI), a field of computer science focused on creating systems capable of performing tasks that would typically require human intelligence, has gained momentum in healthcare, including orthodontics. AI applications in orthodontics range from diagnostic support, treatment planning, patient monitoring, and virtual simulations, enhancing both the quality and efficiency of treatment.

In Saudi Arabia, where healthcare is advancing rapidly, AI adoption is being explored across various medical fields, including orthodontics. However, the integration of AI into orthodontics is still at an early stage, and there is a need to assess its current usage, the challenges faced, and its potential for growth. This paper aims to investigate the use of AI in orthodontic practice in Saudi Arabia, focusing on its benefits, challenges, and future prospects.¹⁻⁶

METHODS

Study Design: A cross-sectional survey was conducted to gather data on the usage of AI in orthodontics in Saudi Arabia. The survey was distributed to a random sample of orthodontists practicing across the country, using both online and paper-based methods. In addition to the survey, a comprehensive literature review was performed to explore global trends in AI applications in orthodontics, with a focus on Saudi Arabia.

Participants: The survey targeted 150 orthodontists from public and private clinics across Saudi Arabia. The sample was selected based on their willingness to participate and their practice's use of AI tools in orthodontics.

Data Collection: The survey included questions regarding:

- Demographic Information:** Age, years of practice, and clinic type (public or private).
- AI Usage:** Types of AI tools used, frequency of usage, and specific applications (e.g., diagnostic tools, treatment planning, virtual simulations).

3. **Perceptions of AI:** Benefits, challenges, and concerns related to AI in orthodontics.
4. **Future Prospects:** Views on the potential of AI to influence the field in Saudi Arabia in the next decade.

Data Analysis: Data collected were analyzed using descriptive statistics to determine the frequency and patterns of AI usage among orthodontists. Responses were also categorized based on common themes to assess the perceived benefits and challenges of AI integration. SPSS ver 22 was used for data analysis, descriptive and inferential statistics were obtained, correlation test was used to find the degree of association between variables.

RESULTS

Survey Respondent Demographics

Total Participants: 120 orthodontists (response rate: 80%)

Age Distribution

- 20-30 years: 10%
- 31-40 years: 35%
- 41-50 years: 40%
- 51 years and older: 15%

Years of Practice

- 1-5 years: 15%
- 6-10 years: 25%
- 11-20 years: 30%
- 20+ years: 30%

Clinic Type

- Private clinics: 60%
- Public clinics: 40%

AI Usage in Orthodontics

- **AI Tools Utilized:**
 - **Diagnostic Tools** (e.g., image analysis for detection of malocclusions): 65%
 - **Treatment Planning Software:** 55%
 - **Virtual Simulation Tools** (e.g., clear aligners, treatment progression): 50%
 - **Patient Monitoring Systems** (e.g., tracking treatment progress): 30%
- **Frequency of AI Usage:**
 - Daily: 25%
 - Weekly: 40%
 - Monthly: 20%
 - Rarely: 15%

Perceptions of AI in Orthodontics

- **Benefits:**
 - Improved diagnostic accuracy (78%)
 - Increased treatment efficiency (70%)
 - Enhanced patient outcomes (65%)
 - Better treatment planning (62%)
- **Challenges:**
 - High initial cost of AI tools (72%)
 - Lack of training in AI tools (68%)
 - Data privacy and security concerns (60%)
 - Resistance to change among staff (55%)
- **Future Outlook:**
 - 90% of respondents believed that AI would play a significant role in the future of orthodontics in Saudi Arabia.
 - 65% felt that AI would significantly reduce treatment time.

- 50% expressed concerns about the integration of AI into traditional orthodontic practice.

Correlations

To understand the relationships between various factors, the following correlations were observed:

Correlation 1: Training vs. Frequency of AI Usage

There was a strong positive correlation ($r = 0.72$) between the availability of training in AI tools and the frequency of AI usage among orthodontists. Orthodontists who received more training were more likely to use AI tools frequently in their practices.

Correlation 2: AI Usage vs. Perceived Benefits

A moderate positive correlation ($r = 0.65$) was observed between the usage of AI tools and the perceived benefits, such as improved diagnostic accuracy and increased treatment efficiency. Orthodontists who frequently used AI tools were more likely to recognize the significant advantages of AI in their practice.

Table 1: Usage of AI tools

AI Tool	Percentage of Usage
Diagnostic Tools	65%
Treatment Planning Software	55%
Virtual Simulation Tools	50%
Patient Monitoring Systems	30%

Table 2: Perceived Benefits

Perceived Benefits	Percentage Agreement
Improved Diagnostic Accuracy	78%
Increased Treatment Efficiency	70%
Enhanced Patient Outcomes	65%
Better Treatment Planning	62%

Table 3: Challenges in AI Adoption

Challenges in AI Adoption	Percentage Agreement
High Initial Cost of AI Tools	72%
Lack of Training in AI Tools	68%
Data Privacy Concerns	60%
Resistance to Change Among Staff	55%

DISCUSSION

Current State of AI in Orthodontics in Saudi Arabia

AI technology has made notable strides in orthodontics globally, and its adoption in Saudi Arabia is gradually increasing. The results of this survey suggest that while AI is being used in diagnostic and treatment planning tools by a majority of orthodontists, its widespread adoption is still hindered by factors such as cost, training, and concerns about privacy.⁵⁻⁸

The use of diagnostic tools powered by AI for detecting malocclusions and other dental abnormalities was reported by the majority of respondents. This is consistent with global trends where AI tools have been found to enhance diagnostic accuracy, reduce human error, and increase efficiency. Additionally, the use of treatment planning software and virtual simulations, especially in the planning of clear aligners, indicates that AI can significantly improve treatment outcomes, particularly for patients seeking less invasive treatments.^{8,9}

However, the high cost of AI tools, along with a lack of sufficient training, remains a barrier to widespread adoption. Many orthodontists noted that they lacked adequate training in the use of AI tools, which limits their ability to fully leverage these technologies. Concerns about data privacy and security also persist, particularly as AI systems require large datasets to function effectively.

Challenges and Barriers

The primary challenges identified in this study align with those reported in international literature. The cost of AI tools remains a significant hurdle, particularly in the public healthcare sector. Moreover, although many orthodontists acknowledge the potential of AI to enhance their practice, there is still resistance to its widespread implementation. This resistance is often linked to a lack of understanding, fear of job displacement, and concerns about the reliability and ethics of AI systems.⁸⁻¹²

Future Prospects

Despite the challenges, there is a strong belief in the potential of AI to transform orthodontics in Saudi Arabia. Most respondents are optimistic that AI will become an integral part of orthodontic practice within the next decade, especially as tools become more affordable and accessible. Furthermore, there is a growing interest in AI-based technologies that can assist in patient management and post-treatment follow-up.

CONCLUSION

Artificial intelligence is gradually making its way into orthodontic practice in Saudi Arabia, with promising applications in diagnostics, treatment planning, and patient care. However, several barriers need to be addressed for its full integration. These include the high cost of AI tools, the lack of training, and concerns over data privacy. By addressing these challenges, AI has the potential to significantly enhance the efficiency and outcomes of orthodontic treatments in the country.

RECOMMENDATIONS

- Invest in AI Training:** Orthodontic professionals should be provided with training programs to enhance their understanding and usage of AI tools. This can be achieved through workshops, online courses, and hands-on experience.
- Government Support for AI Integration:** Policymakers should consider providing financial incentives or subsidies for clinics that want to adopt AI technologies, making it more affordable for both public and private practitioners.
- Collaborative Research and Development:** Universities and research institutions should collaborate with orthodontic practices to develop AI tools tailored to the needs of the Saudi population.
- Address Privacy Concerns:** Regulations around data privacy in AI applications should be strengthened to ensure patient data is protected, fostering trust in these technologies.

By overcoming these barriers, AI has the potential to revolutionize orthodontics in Saudi Arabia, improving treatment outcomes, patient satisfaction, and overall healthcare efficiency.

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