



**MATERIALS AND METHODS**

This cross-sectional study was performed among dental students to explore perspectives of Saudi Arabian dental students on the impact of AI in dentistry. The research project was approved by Institutional Review Board for Health Sciences Colleges Research on Human Subjects, King Saud University (KSU-IRB 017E).

The survey consisted of 18 questions addressing the perspectives of Saudi Arabian dental students on the impact of AI in dentistry. Research questions were developed by Emir Yüzbaşıoğlu et al.[16]. The first section of the questionnaire gathered data concerning social and demographic characteristics. This section included genders and grade levels of dental students (two questions). In the next section, the questions concerned several areas: (1) Sources of information of contemporary AI technologies used in everyday life, (2) Basic knowledge about the working principle of AI, and (3) Use of AI in dentistry. In the last section, 15 statements were presented to the participants who were asked about their level of agreement (disagree, strongly disagree, neutral, agree, or strongly agree).

The participants included undergraduate dental students

anonymously through email between February 1, 2021 and April 1, 2021 using a Google forms (Google LLC).

Data were analyzed using SPSS 26.0 version statistical software (IBM Inc., Chicago, USA). Descriptive statistics (frequencies and percentages) were used to describe the categorical variables. Pearson’s chi-square test was used to compare the distribution of the ordinal scale responses of attitude statements towards AI and also to compare the responses of attitude statements towards AI across the categorical study variables. A p-value of ≤ 0.05 was used to indicate the statistical significance of the results.

**RESULTS**

Out of 218 study subjects, 53.2% were male, the five grades of subjects were evenly distributed, and a higher proportion (60.6%) of subjects obtained information about AI from social media. Most of them (77.1%) were not aware of the basic knowledge about the working principles of AI, and 63.3% of them were not aware of the application of AI in dentistry (Table 1).

**Table 1: Distribution of the gender, grade, source of information and knowledge about AI of students participated in the study (n=218).**

Study variables	No. (%)
Gender	
Male	116(53.2)
Female	102(46.8)
Grade	
1st	41(18.8)
2nd	46(21.1)
3rd	43(19.7)
4th	44(20.2)
5th	44(20.2)
Source of information about AI	
Friends, Family etc.	58(26.6)
Newspaper, magazines etc.	17(7.8)
Lectures in university	11(5.0)
Social media (Facebook, Instagram etc.)	132(60.6)
Do you know the basic knowledge about the working principle of AI?	
Yes	50(22.9)
No	168(77.1)
Do you know the application of AI in dentistry?	
Yes	80(36.7)
No	138(63.3)

The distribution of the 5-point scale responses of attitude statements toward AI in dentistry indicates highly statistically significant differences for the 13 statements.

A higher proportion of subjects (52.8% and 21.1%) responded with agree and strongly agree for the statement “I think artificial intelligence will lead to major

advances in dentistry and medicine”, a result that is highly statistically significant ( $p < 0.001$ ). Also, for the statement “I find the use of artificial intelligence in dentistry and medicine exciting”, about 64% of them responded with agree and strongly agree, results that are significantly higher than other responses ( $p < 0.001$ ). More than 50% of the study subjects responded with agree and strongly agree for the four attitude statements, which are related to radiographic diagnoses of tooth caries, periodontal diseases, and pathologies in the jaws, three-dimensional (3D) implant positioning and planning, and two attitude statements, which are related to undergraduate and postgraduate dental training programs. The proportion of responses (agree and strongly agree) to these six statements were significantly higher than the other responses (strongly disagree, disagree, and neutral;  $p < 0.001$ ). However, more than 60% responded as strongly disagree and disagree for the statement “Artificial intelligence can replace dentists/

physicians in the future”, which shows highly statistically significant differences in the responses ( $p < 0.001$ ). Also, more than 50% of the subjects responded with strongly disagree and disagree for the three statements “Artificial intelligence can be used as a ‘definitive diagnostic tool’ in the diagnosis of disease”, “Artificial intelligence can be used as a ‘prognostic tool’ to predict the course of a disease and determine whether there is a chance of recovery”, and “Artificial intelligence can be used in forensic dentistry”, which is statistically significantly higher than other responses (neutral, agree, and strongly agree;  $p < 0.001$ ). Distribution and comparison of attitude statements responses toward AI in dentistry are shown in Table 2.

The distribution and comparison of the 5-point scale responses of attitude statements toward AI in relation to gender shows no statistically significant difference for the 13 statements as shown in Table 3.

**Table 2: Distribution and comparison of responses to questions about students’ perspective toward AI.**

Statements	Responses					X2-value	p-value
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
I think artificial intelligence will lead to major advances in dentistry and medicine	--	18(8.3)	39(17.9)	115(52.8)	46(21.1)	97.34	<0.001
Artificial intelligence can replace dentists/ physicians in the future.	66(30.3)	74(33.9)	48(22.0)	23(10.6)	7(3.2)	73.61	<0.001
I find the use of artificial intelligence in dentistry and medicine exciting.	3(1.4)	33(15.1)	42(19.3)	109(50.0)	31(14.2)	142.18	<0.001
Artificial intelligence can be used as a “definitive diagnostic tool” in the diagnosis of disease	17(7.8)	72(33.0)	58(26.6)	63(28.9)	8(3.7)	77.18	<0.001
Artificial intelligence can be used as a “prognostic tool” to predict the course of a disease and determine whether there is a chance of recovery.	15(6.9)	54(24.8)	61(28.0)	77(35.3)	11(5.0)	78.15	<0.001
Artificial intelligence can be used as a “treatment planning tool” in diagnosis and treatment planning in dentistry.	19(8.7)	53(24.3)	50(22.9)	80(36.7)	16(7.3)	64.71	<0.001
Artificial intelligence can be used for radiographic diagnosis of tooth caries.	7(3.2)	33(15.1)	61(28.0)	89(40.8)	28(12.8)	93.1	<0.001

Artificial intelligence can be used in the radiographic diagnosis of periodontal diseases	6(2.8)	35(16.1)	62(28.4)	86(39.4)	29(13.3)	88.01	<0.001
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaws.	8(3.7)	37(17.0)	58(26.6)	87(39.9)	28(12.8)	83.61	<0.001
Artificial intelligence can be used in forensic dentistry.	7(3.2)	42(19.3)	91(41.7)	67(30.7)	11(5.0)	119.25	<0.001
Artificial intelligence can be used in 3-dimensional implant positioning and planning	8(3.7)	22(10.1)	53(24.3)	89(40.8)	46(21.1)	89.2	<0.001
Artificial intelligence applications should be part of undergraduate dental training.	2(0.9)	29(13.3)	43(19.7)	97(44.5)	47(21.6)	110.26	<0.001
Artificial intelligence applications should be part of postgraduate dental training.	1(0.9)	4(1.8)	46(21.1)	93(42.7)	74(33.9)	154.89	<0.001

**Table 3: Comparison of responses to questions about students’ perspective toward AI between male and female study subjects.**

Statements	Gender		X2-value	p-value
	Male	Female		
I think artificial intelligence will lead to major advances in dentistry and medicine				
Strongly disagree	--	--	7.252	0.064
Disagree	15(12.9)	3(2.9)		
Neutral	20(17.2)	19(18.6)		
Agree	57(49.1)	58(56.9)		
Strongly agree	24(20.7)	22(21.6)		
Artificial intelligence can replace dentists/physicians in the future.				
Strongly disagree	39(33.6)	27(26.5)	7.537	0.11
Disagree	34(29.3)	40(39.2)		
Neutral	22(19.0)	26(25.5)		
Agree	17(14.7)	6(5.9)		
Strongly agree	4(3.4)	3(2.9)		
I find the use of artificial intelligence in dentistry and medicine exciting.				
Strongly disagree	2(1.7)	1(1.0)	4.271	0.371
Disagree	20(17.2)	13(12.7)		
Neutral	25(21.6)	17(16.7)		

Agree	57(49.1)	52(51.0)		
Strongly agree	12(10.3)	19(18.6)		
Artificial intelligence can be used as a "definitive diagnostic tool" in the diagnosis of disease				
Strongly disagree	13(11.2)	4(3.9)	9.091	0.059
Disagree	38(32.8)	34(33.3)		
Neutral	30(25.9)	28(27.5)		
Agree	34(29.3)	29(28.4)		
Strongly agree	1(0.9)	7(6.9)		
Artificial intelligence can be used as a "prognostic tool" to predict the course of a disease and determine whether there is a chance of recovery				
Strongly disagree	8(6.9)	7(6.9)	3.44	0.487
Disagree	32(27.6)	22(21.6)		
Neutral	31(26.7)	30(29.4)		
Agree	37(31.9)	40(39.2)		
Strongly agree	8(6.9)	3(2.9)		
Artificial intelligence can be used as a "treatment planning tool" in diagnosis and treatment planning in dentistry.				
Strongly disagree	12(10.3)	7(6.9)	1.728	0.786
Disagree	30(25.9)	23(22.5)		
Neutral	26(22.4)	24(23.5)		
Agree	39(33.6)	41(40.2)		
Strongly agree	9(7.8)	7(6.9)		
Artificial intelligence can be used for radiographic diagnosis of tooth caries.				
Strongly disagree	3(2.6)	4(3.9)	4.856	0.302
Disagree	22(19.0)	11(10.8)		
Neutral	34(29.3)	27(26.5)		
Agree	41(35.3)	48(47.1)		
Strongly agree	16(13.8)	12(11.8)		
Artificial intelligence can be used in the radiographic diagnosis of periodontal diseases				
Strongly disagree	2(1.7)	4(3.9)	3.856	0.426
Disagree	23(19.8)	12(11.8)		
Neutral	34(29.3)	28(27.5)		
Agree	43(37.1)	43(42.2)		
Strongly agree	14(12.1)	15(14.7)		
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaws.				
Strongly disagree	4(3.4)	4(3.9)	5.148	0.272
Disagree	25(21.6)	12(11.8)		
Neutral	28(24.1)	30(29.4)		
Agree	42(36.2)	45(44.1)		
Strongly agree	17(14.7)	11(10.8)		
Artificial intelligence can be used in forensic dentistry.				
Strongly disagree	3(2.6)	4(3.9)	5.215	0.266
Disagree	27(23.3)	15(14.7)		
Neutral	51(44.0)	40(39.2)		

Agree	31(26.7)	36(35.3)		
Strongly agree	4(3.4)	7(6.9)		
Artificial intelligence can be used in 3-dimensional implant positioning and planning				
Strongly disagree	6(5.2)	2(2.0)	3.862	0.425
Disagree	14(12.1)	8(7.8)		
Neutral	24(20.7)	29(28.4)		
Agree	48(41.4)	41(40.2)		
Strongly agree	24(20.7)	22(21.6)		
Artificial intelligence applications should be part of undergraduate dental training.				
Strongly disagree	2(1.7)	0(0.0)	5.481	0.241
Disagree	16(13.8)	13(12.7)		
Neutral	24(20.7)	19(18.6)		
Agree	55(47.4)	42(41.2)		
Strongly agree	19(16.4)	28(27.5)		
Artificial intelligence applications should be part of postgraduate dental training				
Strongly disagree	1(0.9)	0(0.0)	2.978	0.561
Disagree	3(2.6)	1(1.0)		
Neutral	25(21.6)	21(20.6)		
Agree	52(44.8)	41(40.2)		
Strongly agree	35(30.2)	39(38.2)		

The distribution and comparison of the 5-point scale responses of attitude statements toward AI in relation to the binary response to the question “ Do you know the basic knowledge about the working principle of AI?” are shown in Table 4. Statistically significant differences for nine attitude statements for which higher proportion of subjects who had basic knowledge about working principle of AI had responded positively (as agree and strongly agree) when compared with the subjects who

did not had have basic knowledge about working principle of AI ( $p < 0.05$ ). For one statement “Artificial intelligence can replace dentists/physicians in the future”, more than 50% of them responded with strongly disagree and disagree even though they had knowledge about working principles of AI, which is statistically significant ( $p < 0.0001$ ). For the other two statements, the responses were not statistically significantly different ( $p > 0.05$ ).

**Table.4: Comparison of responses to questions about students’ perspective toward AI in relation to study subject’s response for basic knowledge about the working principle of AI.**

Statements	Do you know the basic knowledge about the working principle of AI		X2-value	p-value
	Yes	No		
I think artificial intelligence will lead to major advances in dentistry and medicine				
Strongly disagree	--	--	8.006	0.046
Disagree	1(2.0)	17(10.1)		
Neutral	6(12.0)	33(19.6)		
Agree	27(54.0)	88(52.4)		
Strongly agree	26(32.0)	30(17.9)		
Artificial intelligence can replace dentists/physicians in the future.				
Strongly disagree	8(16.0)	58(34.5)	28.82	<0.0001
Disagree	18(36.0)	56(33.3)		
Neutral	10(20.0)	38(22.6)		
Agree	7(14.0)	16(9.5)		
Strongly agree	7(14.0)	0(0.0)		

I find the use of artificial intelligence in dentistry and medicine exciting.				
Strongly disagree	1(2.0)	2(1.2)	13.573	0.009
Disagree	0(0)	33(19.6)		
Neutral	12(24.0)	30(17.9)		
Agree	26(52.0)	83(49.4)		
Strongly agree	11(22.0)	20(11.9)		
Artificial intelligence can be used as a "definitive diagnostic tool" in the diagnosis of disease				
Strongly disagree	4(8.0)	13(7.7)	22.12	<0.0001
Disagree	12(24.0)	60(35.7)		
Neutral	10(20.0)	48(28.6)		
Agree	17(34.0)	46(27.4)		
Strongly agree	7(14.0)	1(0.6)		
Artificial intelligence can be used as a "prognostic tool" to predict the course of a disease and determine whether there is a chance of recovery.				
Strongly disagree	0(0)	15(8.9)	9.25	0.055
Disagree	10(20.0)	44(26.2)		
Neutral	13(26.0)	48(28.6)		
Agree	25(50.0)	52(31.0)		
Strongly agree	2(4.0)	9(5.4)		
Artificial intelligence can be used as a "treatment planning tool" in diagnosis and treatment planning in dentistry.				
Strongly disagree	2(4.0)	17(10.1)	11.243	0.024
Disagree	7(14.0)	46(27.4)		
Neutral	9(18.0)	41(24.4)		
Agree	26(52.0)	54(32.1)		
Strongly agree	6(12.0)	10(6.0)		
Artificial intelligence can be used for radiographic diagnosis of tooth caries.				
Strongly disagree	0(0.0)	7(4.2)	12.176	0.016
Disagree	5(10.0)	28(16.7)		
Neutral	13(26.0)	48(28.6)		
Agree	19(38.0)	70(41.7)		
Strongly agree	13(26.0)	15(8.9)		
Artificial intelligence can be used in the radiographic diagnosis of periodontal diseases				
Strongly disagree	0(0.0)	6(3.6)	20.522	<0.0001
Disagree	3(6.0)	32(19.0)		
Neutral	11(22.0)	51(30.4)		
Agree	21(42.0)	65(38.7)		
Strongly agree	15(30.0)	14(8.3)		
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaws.				
Strongly disagree	2(4.0)	6(3.6)	22.204	<0.0001
Disagree	7(14.0)	30(17.9)		
Neutral	8(16.0)	50(29.8)		
Agree	17(34.0)	70(41.7)		
Strongly agree	16(32.0)	12(7.1)		
Artificial intelligence can be used in forensic dentistry.				
Strongly disagree	1(2.0)	6(3.6)	13.482	0.009
Disagree	6(12.0)	36(21.4)		
Neutral	18(36.0)	73(43.5)		
Agree	18(36.0)	49(29.2)		
Strongly agree	7(14.0)	4(2.4)		
Artificial intelligence can be used in 3-dimensional implant positioning and planning				
Strongly disagree	4(8.0)	4(2.4)	9.118	0.058
Disagree	1(2.0)	21(12.5)		
Neutral	12(24.0)	41(24.4)		
Agree	19(38.0)	70(41.7)		
Strongly agree	14(28.0)	32(19.0)		
Artificial intelligence applications should be part of undergraduate dental training.				

Strongly disagree	0(0.0)	2(1.2)	4.459	0.347
Disagree	4(8.0)	25(14.9)		
Neutral	7(14.0)	36(21.4)		
Agree	26(52.0)	71(42.3)		
Strongly agree	13(26.0)	34(20.2)		
Artificial intelligence applications should be part of postgraduate dental training				
Strongly disagree	0(0.0)	1(0.6)	--	--*
Disagree	0(0.0)	4(2.4)		
Neutral	11(22.0)	35(20.8)		
Agree	21(42.0)	72(42.9)		
Strongly agree	18(36.0)	56(33.3)		
*not applicable due to small frequencies				

Distribution and comparison of the 5-point scale responses of attitude statements toward AI in relation to the binary response to the question “Do you know the application of AI” are shown in Table 5. Significant differences for 11 attitude statements in which higher proportion of subjects who had basic knowledge about working principle of AI had responded positively (as

agree and strongly agree) were found when compared with the subjects who does not know the application of AI ( $p < 0.01$ ). For one statement, “Artificial intelligence can replace dentists/physicians in the future”, more than 50% of them responded as strongly disagree and disagree even though they know the application of AI which is statistically significant ( $p = 0.023$ ).

**Table 5: Comparison of responses to questions about students’ perspective toward AI in relation to study subject’s response for the application of AI.**

Statements	Do you know the application of AI		X2-value	p-value
	Yes	No		
I think artificial intelligence will lead to major advances in dentistry and medicine				
Strongly disagree	--	--	18.681	<0.0001
Disagree	3(3.8)	15(10.9)		
Neutral	5(6.3)	34(24.6)		
Agree	48(60.0)	67(48.6)		
Strongly agree	24(30.0)	22(15.9)		
Artificial intelligence can replace dentists/physicians in the future.				
Strongly disagree	14(17.5)	52(37.7)	11.299	0.023
Disagree	33(41.3)	41(29.7)		
Neutral	19(22.5)	30(21.7)		
Agree	12(15.0)	11(8.0)		
Strongly agree	3(3.8)	4(2.9)		
I find the use of artificial intelligence in dentistry and medicine exciting.				
Strongly disagree	1(1.3)	2(1.4)	21.43	<0.0001
Disagree	4(5.0)	29(21.0)		
Neutral	9(11.3)	33(23.9)		
Agree	48(60.0)	61(44.2)		
Strongly agree	18(22.5)	13(9.4)		
Artificial intelligence can be used as a “definitive diagnostic tool” in the diagnosis of disease				
Strongly disagree	4(5.0)	13(9.4)	18.103	0.001
Disagree	27(33.8)	45(32.6)		
Neutral	11(13.8)	47(34.1)		
Agree	33(41.3)	30(21.7)		
Strongly agree	5(6.3)	3(2.2)		
Artificial intelligence can be used as a “prognostic tool” to predict the course of a disease and determine whether there is a chance of recovery.				
Strongly disagree	0(0.0)	15(10.9)	26.271	<0.0001
Disagree	22(27.5)	32(23.2)		
Neutral	13(16.3)	48(34.8)		
Agree	42(52.5)	35(25.4)		
Strongly agree	3(3.8)	8(5.8)		

Artificial intelligence can be used as a "treatment planning tool" in diagnosis and treatment planning in dentistry.				
Strongly disagree	2(2.5)	17(12.3)	22.986	<0.0001
Disagree	22(27.5)	31(22.5)		
Neutral	8(10.0)	42(30.4)		
Agree	39(48.9)	41(29.7)		
Strongly agree	9(11.3)	7(5.1)		
Artificial intelligence can be used for radiographic diagnosis of tooth caries.				
Strongly disagree	0(0.0)	7(5.1)	43.162	<0.0001
Disagree	5(6.3)	28(20.3)		
Neutral	9(11.3)	52(37.7)		
Agree	49(61.3)	40(29.0)		
Strongly agree	17(21.3)	11(8.0)		
Artificial intelligence can be used in the radiographic diagnosis of periodontal diseases				
Strongly disagree	0(0.0)	6(4.3)	57.921	<0.0001
Disagree	5(6.3)	30(21.7)		
Neutral	6(7.5)	56(40.6)		
Agree	50(62.5)	36(26.1)		
Strongly agree	19(23.8)	10(7.2)		
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaws.				
Strongly disagree	2(2.5)	6(4.3)	55.162	<0.0001
Disagree	7(8.8)	30(21.7)		
Neutral	4(5.0)	54(39.1)		
Agree	46(57.5)	41(29.7)		
Strongly agree	21(26.3)	7(5.1)		
Artificial intelligence can be used in forensic dentistry.				
Strongly disagree	0(0.0)	7(5.1)	16.528	0.002
Disagree	9(11.3)	33(23.9)		
Neutral	31(38.8)	60(43.5)		
Agree	33(41.3)	34(24.6)		
Strongly agree	7(8.8)	4(2.9)		
Artificial intelligence can be used in 3-dimensional implant positioning and planning				
Strongly disagree	3(3.8)	5(3.6)	19.393	0.001
Disagree	3(3.8)	19(13.8)		
Neutral	12(15.0)	41(29.7)		
Agree	35(43.8)	54(39.1)		
Strongly agree	27(33.8)	19(13.8)		
Artificial intelligence applications should be part of undergraduate dental training.				
Strongly disagree	0(0.0)	2(1.4)	27.057	<0.0001
Disagree	6(7.5)	23(16.7)		
Neutral	7(8.8)	36(26.1)		
Agree	37(46.3)	60(43.5)		
Strongly agree	30(37.5)	17(12.3)		
Artificial intelligence applications should be part of postgraduate dental training				
Strongly disagree	0(0.0)	1(0.7)	--	--*
Disagree	0(0.0)	4(2.9)		

Neutral	9(11.3)	37(26.8)
Agree	30(37.5)	63(45.7)
Strongly agree	41(51.3)	33(23.9)

\*not applicable due to small frequencies

The distribution and comparison of the 5-point scale responses of attitude statements toward AI in relation to the study subject's year of study (preclinical and clinical) are shown in Table 6. Statistically significant differences for six attitude statements for which higher proportion of subjects who were in their clinical years of study responded positively (as agree and strongly agree) when compared with the subjects who were in preclinical years of study. ( $p < 0.01$ ). For one statement, "Artificial intelligence can replace dentists/physicians in the future", about 65% of them who were in their clinical study years responded as strongly disagree and disagree,

and 12% of them as agree, results that are statistically significantly higher than the responses of the subjects who were in preclinical years of study ( $p = 0.007$ ). For one statement "Artificial intelligence applications should be part of postgraduate dental training", more than 80% of the subjects who were in preclinical years of study responded as agree and strongly agree, results that are significantly higher than the responses of the subjects who were in clinical years of study ( $p = 0.042$ ). For four statements addressing attitudes, the responses were not significantly different between the subject of preclinical and clinical years of study.

**Table 6: Comparison of responses to questions about students' perspective toward AI between study subjects and preclinical and clinical years.**

Statements	Study years		X2-value	p-value
	Pre-clinical	Clinical		
I think artificial intelligence will lead to major advances in dentistry and medicine				
Strongly disagree	--	--	2.883	0.41
Disagree	6(6.9)	12(9.2)		
Neutral	13(14.9)	26(19.8)		
Agree	52(59.8)	63(48.1)		
Strongly agree	16(18.4)	30(22.9)		
Artificial intelligence can replace dentists/physicians in the future.				
Strongly disagree	30(34.5)	36(27.5)	13.974	0.007
Disagree	24(27.6)	50(38.2)		
Neutral	19(21.8)	29(22.1)		
Agree	7(8.0)	16(12.2)		
Strongly agree	7(8.0)	0(0.0)		
I find the use of artificial intelligence in dentistry and medicine exciting.				
Strongly disagree	2(2.3)	1(0.8)	4.049	0.399
Disagree	10(11.5)	23(17.6)		
Neutral	20(23.0)	22(16.8)		
Agree	45(51.7)	64(48.9)		
Strongly agree	10(11.5)	21(16.0)		
Artificial intelligence can be used as a "definitive diagnostic tool" in the diagnosis of disease				
Strongly disagree	5(5.7)	12(9.2)	6.256	0.181
Disagree	27(31.0)	45(34.4)		
Neutral	29(33.3)	29(22.1)		
Agree	21(21.4)	42(32.1)		
Strongly agree	5(5.7)	3(2.3)		
Artificial intelligence can be used as a "prognostic tool" to predict the course of a disease and determine whether there is a chance of recovery.				
Strongly disagree	1(1.1)	14(10.7)	12.108	0.017
Disagree	21(24.1)	33(25.2)		
Neutral	30(34.5)	31(23.7)		
Agree	28(32.2)	49(37.4)		
Strongly agree	7(8.0)	4(3.1)		
Artificial intelligence can be used as a "treatment planning tool" in diagnosis and treatment planning in dentistry.				
Strongly disagree	5(5.7)	14(10.7)	17.646	0.001
Disagree	23(26.4)	30(22.9)		
Neutral	27(31.0)	23(17.6)		

Agree	21(24.1)	59(45.0)		
Strongly agree	11(12.6)	5(3.8)		
Artificial intelligence can be used for radiographic diagnosis of tooth caries.				
Strongly disagree	1(1.1)	6(4.6)	23.661	<0.0001
Disagree	15(17.2)	18(13.7)		
Neutral	37(42.5)	24(18.3)		
Agree	21(24.1)	68(51.9)		
Strongly agree	13(14.9)	15(11.5)		
Artificial intelligence can be used in the radiographic diagnosis of periodontal diseases				
Strongly disagree	1(1.1)	5(3.8)	10.569	0.032
Disagree	15(17.2)	20(15.3)		
Neutral	33(37.9)	29(22.1)		
Agree	25(28.7)	61(46.6)		
Strongly agree	13(14.9)	16(12.2)		
Artificial intelligence can be used in the radiographic diagnosis of pathologies in the jaws.				
Strongly disagree	3(3.4)	5(3.8)	9.549	0.039
Disagree	17(19.5)	20(15.3)		
Neutral	31(35.6)	27(20.6)		
Agree	25(28.7)	62(47.3)		
Strongly agree	11(12.6)	17(13.0)		
Artificial intelligence can be used in forensic dentistry.				
Strongly disagree	2(2.3)	5(3.8)	13.886	0.008
Disagree	19(21.8)	23(17.6)		
Neutral	45(51.7)	46(35.1)		
Agree	15(17.2)	52(39.7)		
Strongly agree	6(6.9)	5(3.8)		
Artificial intelligence can be used in 3-dimensional implant positioning and planning				
Strongly disagree	5(5.7)	3(2.3)	13.496	0.009
Disagree	10(11.5)	12(9.2)		
Neutral	30(34.5)	23(17.6)		
Agree	25(28.7)	64(48.9)		
Strongly agree	17(19.5)	29(22.1)		
Artificial intelligence applications should be part of undergraduate dental training.				
Strongly disagree	0(0.0)	2(1.5)	5.414	0.247
Disagree	12(13.8)	17(13.0)		
Neutral	19(21.8)	24(18.3)		
Agree	43(49.4)	54(41.2)		
Strongly agree	13(14.9)	34(26.0)		
Artificial intelligence applications should be part of postgraduate dental training				
Strongly disagree	0(0.0)	1(0.8)	9.882	0.042
Disagree	0(0.0)	4(3.1)		
Neutral	15(17.2)	31(23.7)		
Agree	47(54.0)	46(35.1)		
Strongly agree	25(28.7)	49(37.4)		

### DISCUSSION

Over the last several years, AI applications in medicine have expanded exponentially, which will have an impact on the future of the practice in the medical field, and it is increasingly evident that AI education for medical and dental students is necessary. The current study explored the perspectives of dental students within Saudi Arabia on the impact of AI in dentistry.

The present study indicated 77% of dental students are not aware of the working principle of AI, 63% of the participants are not aware of the application of AI in

dentistry, and 60% of them used social media as their sources of information. This finding is in accordance with a recent study conducted by Wood et al. (2021) with medical students regarding AI in clinical practice in the US [17]. According to their survey, most students (72%) heard about AI from social media. Similar findings were also reported in the study concerning attitudes of Turkish dental students with respect to AI by Emir (2020) in which participants noted that their information was provided more by social media sources than academic ones [16].

AI approaches has been effectively used in the diagnosis of various lesion in caries diagnosis, periodontal diseases, and cystic lesions [6,13,14]. In the present study, the participants indicated that they believe that AI technology could be used for radiographic diagnosis of tooth caries, radiographic diagnoses of periodontal diseases and jaw pathologies, and 3D implant positioning and planning. Similar findings were obtained from a Turkish study in which the participants agreed that AI applications would benefit the dentist when making diagnoses of tooth caries and periodontal diseases [16].

Considering the potential influence of AI technology on the future of the medical field, the need to include these topics in the curriculum exists. It is interesting to note that majority of dental students in clinical and pre-clinical years in the present study agreed that AI should be part of undergraduate and/or postgraduate dental training. The results demonstrate a need to incorporate AI into dental curricula. Our findings support other studies demonstrating that students recognize the importance of AI technologies in their field and their interest to learn new technologies [16–18]

Although dental students believe that AI will revolutionize dentistry in the future, 66% of the participants did not agree that AI will replace human dentists in the future. This finding corresponds with those from other studies in which the students indicated that AI would not replace doctors because of its limitations, such as lack of conversations with patients to earn their trust, reassure them, and/or show empathy [16,18–21]. Moreover, in some cases the doctors need to perform examinations or interpret histories and promote further discussion [22].

It should be noted, nevertheless, that this research has certain limitations. This study was carried out among dental students from one institution. Therefore, the results would not be applicable to other dental schools due to different curricula and dental training programs. Furthermore, because we only looked at undergraduate dental students' attitudes, it is possible that postgraduate or more senior dentist students would express different sentiments.

### CONCLUSION

According to the findings of this study, most Saudi dental students at KSU are enthusiastic about AI application in dentistry. They believe that AI can be used effectively for diagnoses of several diseases. A need to incorporate AI technology in dental curricula for the student to learn these emerging technologies exists. Follow-up surveys and multicentre studies need to be carried out to further investigate these issues.

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