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RESEARCH ARTICLE

Choice of Restorative Materials for Direct Posterior Restorations among Undergraduate Saudi College Students

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Abstract:

Background:

The most common restorative materials used in dentistry are amalgam and composite. Amalgam is a controversial material owing to its mercury toxicity. With recent advances in the properties of composite materials, there has been a shift towards its use.

Objectives:

The aim of this study was to understand the perceptions of undergraduate dental students in a northern Saudi Arabian dental school about the choice of restorative materials for restoring posterior teeth.

Methodology:

The study included undergraduate students studying in 4th and 5th year dental program in College of Dentistry, Jouf University. A four-item questionnaire with 18 close-ended questions was developed by the investigators, which were hand delivered to all the students. Data analysis is presented through tables and descriptive methods.

Results:

A total of 98 (out of 131) undergraduate students participated in this study. Overall, the students reported a significantly strong influence of the type of restorative materials in relation to the cavity size and margin of the restorations along with the esthetics factor ($p < 0.05$). There was slight influence on the student's choice because of the instructor's influence, whereas the students felt they were knowledgeable and had appropriate training to use either amalgam or composite. The study also found that patient's preference had a strong influence on choosing composite material. The students were mostly not influenced while choosing the material as far as the safety of it was concerned. However, the patient's influence was slight when it came to the choice of the material. A significant difference was noted among the students when it came to pregnancy-related safety concerns where the choice of material was not influenced by either amalgam or composite ($p = .002$).

Conclusion:

The undergraduate dental students at College of Dentistry, Jouf University are comfortable in using both amalgam and composite as a posterior restorative material. They are knowledgeable about both the materials and are adequately trained to use either one.

Keywords: Amalgam, Composite, Dental, Posterior, Restoration, Materials.

Article History

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1. INTRODUCTION

Operative dentistry is the field of dentistry which deals with the restoration of decayed and damaged teeth to restore their form and function. Since it involves the restoration of teeth with different dental materials, it is imperative that the

students have thorough knowledge about the properties and manipulation of different restorative materials. Dental amalgam has been used as a first-choice material for restoring posterior teeth for many years [1]. Amalgam is considered a 'gold standard' restorative material for posterior teeth due to its ease of placement, longevity and ability to be used in different working environments [2, 3].

There has been considerable advancement in the

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development of composite materials for the restoration of teeth in the last three decades. The material was initially used to restore anterior teeth only and had inferior properties for use in the posterior teeth. Due to refinement in their properties over the last decade, composite resins have become popular amongst dentists and their clinical longevity has increased [4]. There are multiple applications of contemporary composite resins in restoring anterior as well as posterior teeth [5]

Patients have become increasingly concerned about the toxicity because of mercury present in the amalgam restorations [6]. There has been a paradigm shift from amalgam towards composite restorations due to the possible mercury toxicity and esthetic concerns with respect to amalgam restorations [7, 8]. Fresh graduates and interns are using less dental amalgam as compared to experienced dentists [9]. This may include a variety of reasons ranging from personal choice to ease of work. There is inconsistency in the teaching of composites and amalgam in dental schools, with more focus on composites when the students graduate and practice in the community [10].

Dental amalgam and composites are taught as a restorative material in the undergraduate curriculum in College of Dentistry, Jouf University. BDS is a 5-year program followed by one-year internship wherein students learn about restoration of teeth from their 2nd academic year in the skill courses where they practice on simulation units. From 3rd till 5th academic year, they move to the clinical courses where they treat patients under supervision of qualified faculty. There are limited studies available about the choice of restorative materials by undergraduate dental students in Saudi Arabia with none done in the northern region. Against this background, the aim of the current study was to evaluate the factors which influence the students' preferences for the choice of restorative materials for posterior teeth and the impact of teaching on these choices.

2. MATERIALS AND METHODS

2.1. Study Design

A cross-sectional survey study.

2.2. Study Duration

15th February 2021 till 15th March 2021.

Approval for the study was obtained by the Institutional Ethical Committee (Approval No. 22-06-42) and all the study procedures follow the ethical principles of the Helsinki Declaration.

2.3. Sample Size Calculation

The sample size required has been calculated to be 98 according to the formula:

$$n = [z^2 * p * (1 - p) / e^2] / [1 + (z^2 * p * (1 - p) / (e^2 * N))]$$

where: $z = 1.96$ for a confidence level (α) of 95%, $p =$ proportion (expressed as a decimal), $N =$ population size, $e =$ margin of error.

$$z = 1.96, p = 0.5, N = 131, e = 0.05$$

$$n = [1.96^2 * 0.5 * (1 - 0.5) / 0.05^2] / [1 + (1.96^2 * 0.5 * (1$$

$$- 0.5) / (0.05^2 * 131)]$$

$$n = 384.16 / 3.9325 = 97.688$$

$$n \approx 98$$

2.4. Study Population and Characteristics

The study sample included all the 4th & 5th year undergraduate dental students of the current academic year 2020-21 who had completed their operative dentistry skill courses and were taking the clinical courses. Random convenient sampling was used to select participants. Recruitment was performed by announcements through e-mail. The participation was made voluntary and the purpose of survey was briefed to them before obtaining the informed consent. It was assured in the beginning of the questionnaire itself that the results of the survey would be only presented or published as aggregate data maintaining the confidentiality of personal information.

2.5. Study Tool and Data Collection

The questionnaire was adopted from a study conducted by Lynch *et al.* (2010) [11]. The questionnaire was modified by two experts (faculty members of the department of conservative dentistry). The modified questionnaire was administered to 20 students as a pilot and was retested after one month to the same students to check the reliability by using the Cronbach's alpha test [12]. The Cronbach's alpha coefficient for the questionnaire was more than 0.7 for different sections, which was considered to be relatively high and internally consistent.

The questionnaire comprised of 18 questions that were prepared in Arabic and English Language as well. The first part was related to the choice of the restorative materials based on cavity size and location. The second part was related to the related to the student's knowledge and understanding about the materials and its application. The third part was related to the ease of use of the materials. The last part of the questionnaire was related to the safety of the materials. The responses were recorded on five-point Likert scale with 1 indicating "no answer" whereas 5 indicated "strong influence".

After the validity of the questionnaire was established, it was conveniently hand delivered to all the participating students.

2.6. Statistical Analysis

Data was entered and analyzed by using SPSS version 20.0 (IBM Corp., Armonk, NY). Responses to all the items in the questionnaire were summarized as absolute and relative frequencies. As the response of each item was measured on a 5-point Likert scale thus, non-parametric tests were used for intergroup comparisons. Comparison of score of responses towards different items of the questionnaire was made using Mann Whitney U test. The level of statistical significance was set at $p \leq 0.05$.

3. RESULTS

A total of 98 (out of 131) undergraduate students participated in this study, making a response rate of 74.8%.

The samples consisted of 52 (53.1%) fourth year and 46 (46.9%) fifth year UG students.

3.1. Factors Related to Cavity Size, Location, and Dentition

Table 1 shows the response of the students regarding their choice of material with reference to the size of cavity, location of the tooth and type of dentition. Significant difference ($p=.003$) was noted for the material of choice in relation to the size of cavity where majority (80.6%) of the students felt that the choice of amalgam was strongly influenced by the size of the cavity whereas 60.2% students were strongly influenced to use composite for the same reason. Similarly, significant findings ($p=.000$) were noted in response to the impact of margins of the restorations on the selection of materials, 74.5% were strongly influenced by the type of margins when they opted to use composite whereas only 48.0% were strongly influenced to use amalgam. 18.3% students had slight or no influence on using composite whereas for amalgam this rate

was around 46.9%. Esthetics factor strongly influenced students (87.8%) to choose composite and this rate was slightly less (74.5%) in case of amalgam. With reference to the position of the tooth in the oral cavity, 70.4% students were strongly influenced to choose composite, whereas 83.7% were strongly influenced to use amalgam. While responding to treating deciduous and permanent dentition, 37.8% were strongly influenced to use composite. 42.9% were strongly influenced to use amalgam based on the type of dentition. On the other hand, 34.7% suggested that the type of dentition had no influence on their choice, whether it is amalgam or composite restorative material. Regarding the status of opposing teeth 42.9% students responded that it strongly influenced their choice of composite whereas 20.4% were not influenced to choose composite. Almost same number of 69.4% students stated that this factor had strong to slight influence on their choice of choosing amalgam whereas 29.6% were not influenced to use amalgam because of this reason.

Table 1. Factors related to cavity size, location and dentition.

S.No	Statements	Response Options	Composite		Amalgam		P value
			Number of Responses	(%)*	Number of Responses	(%)*	
1	1. Size of cavity	No Answer	6	6.1%	1	1.0%	.003**
		No Knowledge	0	0.0%	0	0.0%	
		No Influence	15	15.3%	0	0.0%	
		Slight Influence	18	18.4%	18	18.4%	
		Strong Influence	59	60.2%	79	80.6%	
2	2. Margins of cavity (sub or supra gingival)	No Answer	4	4.1%	4	4.1%	.000**
		No Knowledge	3	3.1%	1	1.0%	
		No Influence	2	2.0%	22	22.4%	
		Slight Influence	16	16.3%	24	24.5%	
		Strong Influence	73	74.5%	47	48.0%	
3	3. Esthetic reasons	No Answer	1	1.0%	5	5.1%	.103
		No Knowledge	0	0.0%	1	1.0%	
		No Influence	3	3.1%	3	3.1%	
		Slight Influence	8	8.2%	16	16.3%	
		Strong Influence	86	87.8%	73	74.5%	
4	Position of tooth	No Answer	5	5.1%	4	4.1%	.109
		No Knowledge	0	0.0%	0	0.0%	
		No Influence	3	3.1%	0	0.0%	
		Slight Influence	21	21.4%	12	12.2%	
		Strong Influence	69	70.4%	82	83.7%	
5	Deciduous/permanent dentition	No Answer	4	4.1%	9	9.2%	.841
		No Knowledge	3	3.1%	1	1.0%	
		No Influence	20	20.4%	14	14.3%	
		Slight Influence	34	34.7%	32	32.7%	
		Strong Influence	37	37.8%	42	42.9%	
6	Status of opposing tooth	No Answer	6	6.1%	1	1.0%	.624
		No Knowledge	2	2.0%	0	0.0%	
		No Influence	20	20.4%	29	29.6%	
		Slight Influence	28	28.6%	33	33.7%	
		Strong Influence	42	42.9%	35	35.7%	

*Scale: 1= no answer, 2 = no knowledge, 3 = no influence, 4 = slight influence, and 5 = strong influence.

**Statistically Significant

3.2. Factors Related to Teaching and Knowledge

Table 2 shows the responses related to teaching and knowledge of students regarding the restorative materials. Instructor majorly did not influence the choice of material used. 35.7% were slightly influenced by instructor to choose amalgam; the same was around 28.6% in choosing composite. The factor of clinical training suggested a strong influence of around 53.0% in choosing either material. Almost the same percentage responded to be slightly influenced to choose either of the materials. The knowledge about the material seems to be good enough to strongly influence their choice in both cases as 63.3% students were strongly influenced to choose composite and 65.3% were strongly influenced to choose amalgam. All the aforementioned factors related to teaching and knowledge were found to be insignificant, however with reference to the use of isolation methods, significant difference (p<.0001) was noted where 63.3% students strongly suggested the use of composite over amalgam (19.4%). Half of the participants (50.0%) had no influence on choosing amalgam, whereas it was only 10.0% while choosing composite.

3.3. Factors Related to Case of Use

Table 3 shows the perceptions of the students related to the ease of use of both the restorative materials. 54.1% students were not influenced to use amalgam when it came to the ease of cavity preparation whereas 36.7% were strongly influenced to choose composite. This finding was statistically significant

(p<.00001). The students were also inquired about the influence of their previous experiences on the choice of materials. There was a general trend of 30.0% of participants not being influenced by the factor whereas 29.6% of students were strongly influenced to use composite, this figure halved when it came to choosing amalgam. However, the slight influence was more trended towards amalgam, with 33.7% using composite and 42.9% using amalgam. Almost half of the students suggested that ease of manipulation slightly influenced their choice of composite as a material.

3.4. Factors Related to Patients and Safety of the Materials

Table 4 shows the responses of the students related to the patients and safety of the materials. Patient’s age had no significant influence on the choice of material by the students. About 93.0% choices were strongly and slightly influenced because of the patient’s preference to use composite whereas 58.0% students felt they were slightly influenced in choosing amalgam. Patient’s choice related to safety slightly (50.0%) influenced the choice of composite, however when it came to choosing amalgam, it slightly (59.2%) influenced the respondents. A significant difference (p=.0001) was noted for operator’s choice of material related to safety where students were slightly influenced (57.1%) in choosing composite but they were not influenced (57.1) in choosing amalgam. Regarding pregnancy related concerns, students’ choice was not influenced for any of the dental material and this was found to be statistically significant (p=.002).

Table 2. Factors related to teaching and knowledge.

S.No	Statements	Response Options	Composite		Amalgam		P value
			Number of Responses	(%)*	Number of Responses	(%)*	
1	Instructor's influence	No Answer	19	19.4%	6	6.1%	.111
		No Knowledge	13	13.3%	2	2.0%	
		No Influence	17	17.3%	36	36.7%	
		Slight Influence	28	28.6%	35	35.7%	
		Strong Influence	21	21.4%	19	19.4%	
2	Clinical training	No Answer	2	2.0%	3	3.1%	.976
		No Knowledge	2	2.0%	2	2.0%	
		No Influence	14	14.3%	10	10.2%	
		Slight Influence	27	27.6%	31	31.6%	
		Strong Influence	53	54.1%	52	53.1%	
3	Knowledge about material	No Answer	1	1.0%	0	0.0%	.718
		No Knowledge	3	3.1%	0	0.0%	
		No Influence	8	8.2%	10	10.2%	
		Slight Influence	24	24.5%	24	24.5%	
		Strong Influence	62	63.3%	64	65.3%	
4	Use of isolation methods	No Answer	2	2.0%	0	0.0%	<.00001**
		No Knowledge	0	0.0%	0	0.0%	
		No Influence	10	10.2%	50	51.0%	
		Slight Influence	24	24.5%	29	29.6%	
		Strong Influence	62	63.3%	19	19.4%	

*Scale: 1= no answer, 2 = no knowledge, 3 = no influence, 4 = slight influence, and 5 = strong influence.

**Statistically Significant

Table 3. Factors related to ease of use.

S.No	Statements	Response Options	Composite		Amalgam		P value
			Number of Responses	(%)*	Number of Responses	(%)*	
1	Ease of cavity preparation	No Answer	0	0.0%	1	1.0%	<.00001**
		No Knowledge	0	0.0%	1	1.0%	
		No Influence	5	5.1%	53	54.1%	
		Slight Influence	57	58.2%	32	32.7%	
		Strong Influence	36	36.7%	11	11.2%	
2	Previous experience using the material	No Answer	2	2.0%	4	4.1%	.094
		No Knowledge	5	5.1%	7	7.1%	
		No Influence	29	29.6%	30	30.6%	
		Slight Influence	33	33.7%	42	42.9%	
		Strong Influence	29	29.6%	15	15.3%	
3	Ease of manipulation of material	No Answer	2	2.1%	0	0.0%	.303
		No Knowledge	2	2.1%	0	0.0%	
		No Influence	20	20.6%	36	36.7%	
		Slight Influence	56	57.7%	45	45.9%	
		Strong Influence	17	17.5%	17	17.3%	

*Scale: 1= no answer, 2 = no knowledge, 3 = no influence, 4 = slight influence, and 5 = strong influence.

**Statistically Significant

Table 4. Factors related to patient and safety of material.

S.No	Statements	Response Options	Composite		Amalgam		P value
			Number of Responses	(%)*	Number of Responses	(%)*	
1	Patient's age	No Answer	6	6.1%	4	4.1%	.200
		No Knowledge	0	0.0%	3	3.1%	
		No Influence	41	41.8%	48	49.0%	
		Slight Influence	32	32.7%	32	32.7%	
		Strong Influence	19	19.4%	11	11.2%	
2	Patient's preference	No Answer	2	2.0%	1	1.0%	.004**
		No Knowledge	2	2.0%	1	1.0%	
		No Influence	3	3.1%	11	11.2%	
		Slight Influence	42	42.9%	58	59.2%	
		Strong Influence	49	50.0%	27	27.6%	
3	Patient's choice related to safety	No Answer	4	4.1%	4	4.1%	.114
		No Knowledge	1	1.0%	1	1.0%	
		No Influence	27	27.6%	14	14.3%	
		Slight Influence	49	50.0%	58	59.2%	
		Strong Influence	17	17.3%	21	21.4%	
4	Operator's choice related to safety	No Answer	1	1.0%	2	2.0%	.0001**
		No Knowledge	2	2.0%	1	1.0%	
		No Influence	24	24.5%	56	57.1%	
		Slight Influence	56	57.1%	31	31.6%	
		Strong Influence	15	15.3%	8	8.2%	
5	Pregnancy related concerns	No Answer	10	10.2%	1	1.0%	.002**
		No Knowledge	9	9.2%	0	0.0%	
		No Influence	38	38.8%	47	48.0%	
		Slight Influence	23	23.5%	12	12.2%	
		Strong Influence	18	18.4%	38	38.8%	

*Scale: 1= no answer, 2 = no knowledge, 3 = no influence, 4 = slight influence, and 5 = strong influence.

**Statistically Significant

4. DISCUSSION

The controversy to use or not to use amalgam goes back to

many decades [1]. However, with recent advances in the properties of composite materials, there has been a shift

towards its use [13]. In this study, a questionnaire was used to collect data from dental students. The authors believe that it was a good way to collect data in a short period of time. The response rate of the questionnaire was around 74.8% that was higher than the acceptable level of 64.0% [14]. This response rate is better than some other similar questionnaire-based studies done in dental schools of Saudi Arabia recently [15, 16].

In this study, the size of the cavity and position of tooth in the mouth was a major determinant in selecting amalgam as a restorative material. This finding could be attributed to the common understanding that amalgam lasts more in larger cavities and is stronger in high occlusal stress areas. This finding is similar to studies done by Pani SC *et al.* (2014) [17], who found that amalgam was the material of choice for the restoration of posterior teeth. The students were also confident in using composite restorations for restoring posterior teeth as well. In this study, esthetics was the major driving force for the students to use composite as a restorative material. Composite restorative materials are considered to be more of an esthetic replacement of natural teeth and are replacing amalgam as a tooth-colored replacement of lost tooth structure [18].

The study shows that the students' clinical training and knowledge about the choice of the restorative materials are almost the same. This is because in our institute, the emphasis on amalgam and composite teaching in pre-clinical and clinics is the same, although few years back, the focus was on amalgam only. Akbar (2015) [19] in his study found that dentists in northern part of Saudi Arabian were not comfortable using composite for posterior restorations. His study recommended continued dental education courses for dentists and increased teaching along with clinical training should be provided to dental students for posterior composite restorations. The results of the current study show that the students who will graduate in the next few years are more comfortable in choosing composite as a posterior restorative material and this has been made possible by the change in curriculum in Jouf University with emphasis on composite as well as amalgam. These results are also similar to studies done in European dental schools where they found that students are more comfortable using composites where teaching emphasizes on composites as well as amalgam in the pre-clinical and clinical stage [11]. This clearly indicates a trend shifting towards composite restorations for posterior teeth. The instructor's influence was also found to be unbiased towards a particular material.

In this study, the students considered isolation as an important factor for using composite restorations along with the margins of the restoration. The important of isolation has been determined as a success factor for composite restorations success [20]. It was also noted that students were more biased towards composite material because of the ease of cavity preparation and manipulation of the material. While this trend is similar to studies done in UK and Ireland [21] it is of concern that students are becoming less comfortable with amalgam cavity preparation. When they go out to work in the community, the graduates require to use both amalgam and composite materials. In government settings where patients do

not pay for the treatment, amalgam is still the material of choice for majority of the posterior restorations.

In this study, the safety of amalgam was not a major influencing factor by the students when they decided to choose amalgam. Similarly, the patient's choice regarding the safety of amalgam did not affect the student's selection. A previous study done in Saudi Arabia amongst dentists found it safe to use amalgam while the patients had little knowledge about the possible issues with amalgam [8]. Mercury and mercury products are well-known environmental toxic materials [22]. The Minamata Convention On Mercury regulates the dental fillings where mercury is incorporated and proposes a number of measures to phase down its uses [23].

This study showed that the patient's pregnancy seems to have an impact on the choice of amalgam with students citing it as a strong influencing factor. There is no evidence that dental amalgam will have an impact on the pregnancy and the fetus [24].

This study had one limitation in that only male students were included since we had access to the male section only of our students' clinics, which are completely separated from the male section.

CONCLUSION

To conclude, the students in College of Dentistry, Jouf University, are knowledgeable and comfortable using both amalgam and composite materials for restoring posterior teeth. This is at par with the global trends in restorative dentistry. In contrast with the previous studies done in northern Saudi Arabia that showed the lack of skills of practicing dentists in using composite restorations in posterior teeth has changed over the last few years with changes in curriculum and emphasis on contemporary materials and techniques by the faculty of college of dentistry. However, patient's awareness regarding the materials to be used for restorations in their mouths is found to be limited. Hence it is recommended that the local health authorities run awareness campaigns in order to increase knowledge and understanding of the patients.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval was obtained from the Ethical Committee of Jouf University, Saudi Arabia (approval no. 22-06-42).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent for participation was taken for this study in accordance with the national legislation and the institutional requirements.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available from corresponding author [R.I] upon reasonable request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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